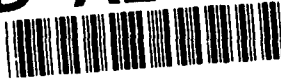


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AVAILABILITY OF Ada AND C++
COMPILERS, TOOLS, EDUCATION, AND TRAINING

Audrey A. Hook, *Task Leader*

William E. Akin
Lewis E. Dimler
Kathleen A. Jordan
R. Danford Lehman
Catherine W. McDonald
Christine Youngblut

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PREFACE

This paper presents the results of a five-week study to determine the comparative availability of compilers, tools, education, and training for the Ada and C++ programming languages.

The delivery of this paper responds to Task Order T-J5-954, which requested the Institute for Defense Analyses (IDA) "to identify, analyze, and report on (1) compiler and automated engineering tools that can support and supplement current software development, integration, test, and support functions of Ada and C++ programming languages and (2) associated training and education available for each language." This report will be one of several information sources used by the Department of Defense in the development of a business case to determine whether any waivers to the Ada requirement may be warranted for business systems.

This document was reviewed by the following members of the Institute for Defense Analyses: Dr. Richard Morton, Dr. Richard Wexelblat, and Dr. Richard Ivanetich.

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1. INTRODUCTION

The use of compilers and tools that support modern software engineering practices has the potential to greatly increase programmer productivity. Many U. S. and European companies are offering off-the-shelf products that support some aspect of the software engineering process with choices of design and development paradigms, and implementation language. The Department of Defense (DoD) is interested in the status of market offerings for software engineering environments to support the software life cycle.

The Institute for Defense Analyses (IDA) was tasked by the Director of Defense Information, Office of Assistant Secretary of Defense (C3I) to identify, analyze, and report on (1) compiler and automated engineering tools that can support and supplement current software development, integration, test, and support functions of Ada and C++ programming languages, and (2) associated training and education available for each language. This report will be one of several information sources used by the DoD in the development of a business case to determine whether any waivers to the Ada requirement for business systems may be warranted.

1.1 BACKGROUND

The Ada programming language, standardized in 1983, is Congressionally mandated for software development within the DoD. The 1983 standard, informally known as Ada83, is currently under revision in the normal American National Standards Institute (ANSI) process. Two important changes planned are an extension of Ada's data abstraction capabilities, adding object-oriented programming features, and improved control over concurrency for real-time applications. The DoD has also established a rigorous compiler testing and validation process used in the U. S. and Europe as a mechanism for determining conformity to the standard.

C++ is an incremental addition to the C language that includes type checking and provides object-oriented programming features. The C language was standardized in 1989 but there is no standard for C++ and no formal compiler testing and validation process for C or C++. Thus, there could be considerable variation among the C++ products reported in this study; time constraints preclude conducting an in-depth analysis of this variability.

1.2 SCOPE

This report documents a five-week effort to collect and analyze information on the market availability of Ada and C++ compilers, tools, education, and training. We have eliminated from discussion such application domains as artificial intelligence, computer-aided design, and embedded systems because the primary focus of this study is on business systems. We also excluded Fourth Generation Languages (4GLs) as a category of Computer-aided Software Engineering (CASE) tools because 4GLs are for the most part proprietary, non-procedural languages that have limited utility during the maintenance phase of a large, complex business application. Where they were reported, we made note of extended compiler libraries that provide interfaces or bindings to other Federal Information Processing Standard (FIPS) languages and protocols and to International Organization for Standards (ISO) libraries. For the purpose of this report, we considered operating system services and utilities generally provided with computer systems as basic extensions to the capabilities of a software engineering environment. Finally, only commercial off-the-shelf (COTS) products available from U. S. vendors were considered in this study.

1.3 DEFINITION OF TERMS

There are many tool vendors who offer products for specific jobs during software development. Some tools are designed for use with a particular programming language, with a particular program development method, or during a specific part of the software life cycle. In this report, we have investigated the availability of tools that are coupled with compilers and those that extend software engineering support of certain phases of the software life cycle. For the purpose of this report, the following definitions of terms apply:

- **Tool:** A tool is a software product or package which serves a quite specific and narrow purpose for programming such as, for example, a source code editor or a static debugger.
- **CASE:** CASE tools are collections of tools that support specific task activities performed during the software life cycle, such as requirements analysis, preliminary design, program testing, or verification.
- **Environment:** An environment is used here to mean computer and communications hardware and software, including operating systems and a tool set for supporting tasks during the software life cycle. Some degree of interoperability among tools may exist but the general translation of data structures and their semantics among tools and environments without loss of information requires further research and development.

1.4 APPROACH

Commercial suppliers of Ada and C++ compilers, CASE tools, and training in the use of Ada and C++ were contacted by telephone to solicit the information used in this study. The source of information concerning commercial suppliers was lists published by the Association for Computer Machinery (ACM) Special Interest Group on Ada (SIGAda), Ada Joint Program Office (AJPO), journals and data collected by IDA in connection with several other tasks such as Ada Technology Insertion and the Strategic Defense Initiative Office (SDIO) Software Technology Plan. Data collected during the survey was analyzed to determine current status and indications of trends of significance to information business systems. Since the information on specific products and training collected during this study may be of interest to others concerned with the application of Ada and C++, it is documented in Appendices A-H.

2. FINDINGS AND DISCUSSION

2.1 Ada COMPILERS AND TOOLS

There are 28 companies located in the U. S. that have Ada compilers with current validated status. The official list of validated Ada compilers published by the AJPO and National Institute of Science and Technology (NIST) pairs Ada compiler names with the computer systems that make up a validated Ada implementation.

For this survey, the following information was solicited from compiler vendors:

- products (how the compiler is marketed and any other tools)
- prices
- maturity (earliest validation date)
- education/training (includes courses and consulting)
- other languages (specifically C++)
- customer base

Table 1 provides the names of companies contacted during this survey along with data on platform type, prices, and primary business of the company.

Appendix A documents the information provided by the compiler vendors.

Table 1. Ada Compiler Vendors

	Price Range		Platform PC/WS/MF*	OS	Training
	low	high			
1. AETECH Compilers	\$795	\$2495	PC	DOS UNIX	Yes
2. Aitech Systems Ltd. Systems	n/a**		n/a		
3. Alliant Computer Systems Systems	\$15,000	\$75,000	MF	Alliant	Yes
4. Alslys Compilers	\$940 \$38,000	\$3,000 \$7,500 \$126,000	PC WS MF	Macintosh DOS UNIX VMS MVFS	Yes
5. Apollo Computer Systems	n/a		n/a		
6. Concurrent Computer Corp. Systems	n/a		n/a		
7. CONVEX Computer Corp. Systems	n/a		n/a		
8. DDC International Compilers	n/a		WS MF	UNIX VMS	
9. Digital Equipment Corp. Systems	\$15,200	\$330,000	WS MF	VMS ULTRIX	Yes
10. E-Systems, Inc. Systems	n/a		n/a		
11. Encore Computer Systems	n/a		n/a		
12. Harris Systems	\$18,500	\$30,000	MF	Harris	Yes
13. Hewlett-Packard Systems	n/a		n/a		
14. IBM, IBM Canada Ltd. System	\$25,000 \$10,000	\$400,000 \$38,000	MF WS	IBM UNIX	

* PC = Portable Computer; WS = Work Station; MF = Main Frame

** n/a = not available

Table 1. Ada Compiler Vendors (continued)

	Price Range		Platform		Training
	low	high	PC/WS/MF*	OS	
15. Intermetrics Compiler	\$50,000	\$30,000	WS MF	VMS MVS	
16. Irvine Compiler Compiler	\$5,000 \$25,000	\$18,000 \$90,000	(self-host) (cross compiler)	VMS UNIX	Yes
17. Meridian Software Systems Compilers	\$249	\$6,500	PC WS	MacIntosh UNIX VMS	Yes
18. MIPS Computer Systems Systems	n/a		n/a		
19. R.R. Software Compilers	n/a		PC	DOS UNIX	Yes
20. Rational Systems	\$25,000	\$48,000	WS/MF	Prop.	Yes
21. Rockwell International Systems	n/a		n/a		
22. SD_SCICON Systems	n/a		WS MF	VMS	Yes
23. Silicon Graphics Systems	n/a		n/a		
24. Tartan Laboratories, Inc. Compilers	\$20,000 \$30,000	\$48,000 \$140,000	WS MF	VMS UNIX	
25. TeleSoft Compilers	\$4,500 \$20,000	\$7,500 \$90,000	WS MF	Sun UNIX	Yes
26. Texas Instruments Systems	n/a		WS	VMS	
27. Verdex Compilers	n/a		WS MF	SUN OS UNIX VMS	
28. Wang Laboratories Systems	n/a		n/a		

* PC = Portable Computer; WS = Work Station; MF = Main Frame

** n/a = not available

2.1.1 Ada programming tools are available with the compiler or as extra options.

All of the vendors provide a minimal set of tools for Ada code development which includes the compiler, editor, debugger, library manager, and runtime environment. Beyond this minimal set, vendors also offer an optimizer, profiler, language-sensitive editor, cross referencer, math library, and simulator (if a cross-compilation system). The major variability of these offerings is whether the tools are bundled in the compiler price or are sold separately. Special tools, such as the language-sensitive editor or profiler, are often part of a package of software engineering tools that can be purchased separately. Bindings to software products such as IBM's database (IMS), graphical data display, and interactive program development facility are provided by several vendors who supply the IBM mainframe Ada environment for business applications. Compiler vendors are beginning to provide bindings to standards such as X-Windows, Structured Query Language (SQL), Programmer's Hierarchical Interactive Graphics (PHIGS), and MOTIF to facilitate development of user interfaces to applications and data.

2.1.2 Ada compilers and tools are hosted on a variety of computer manufacturer equipment and widely available operating systems.

Compilers and environments are offered for personal computers (PCs), workstations, and mainframes that are available on General Services Administration (GSA) schedules, DoD requirements contracts, or are part of the government's installed inventory of general purpose computers. Industry promotion of Motorola and Intel processors has resulted in the availability of compilers that are compatible with PCs and workstations sold under many brand names. The enduring popularity of MS/DOS and UNIX for PCs and workstations is also reflected in the availability of Ada compilers from more than one vendor. For example, four Ada compiler vendors provide compilers for PCs operating under MS/DOS 3.0 or higher while eight vendors provide compilers for UNIX-based operating systems for PCs, workstations (including Reduced Instruction Set Computer (RISC) machines), and mainframe computers. The installed customer base of Digital Equipment Corporation (DEC) in the U. S. is reflected in the number of Ada compiler vendors (six) who provide compilers and tools for DEC's VMS operating system. Three vendors provide compilers and tools for IBM's mainframe operating systems. Two vendors also provide Ada compilers and tools for the Macintosh.

Ada compiler vendors are sensitive to commercial demand for a particular computer and/or operating system. Watching what a compiler vendor drops from his validation schedule is a perceived weakness in commercial demand for a computer system. The cost of obsolescence is unknown; however, it is true that the government must pay higher than typical maintenance fees for

equipment, operating systems, and Ada environments that have been made obsolescent by technology advances. One compiler vendor stated that the maintenance fee is \$50,000 per year for a compiler version that is not a current product. It has been estimated by several compiler vendors that they spend approximately \$100,000 for each compiler version that successfully completes the Ada validation process every two years. Naturally, vendors intend to maximize their return on investment by targeting growing industry markets. However, government users may not be able to find an Ada compiler for vintage Automated Data Processing Equipment (ADPE) and operating systems without paying a compiler vendor to customize a compiler for them.

2.1.3 There are two major vendor categories: compiler developers and system vendors.

The Ada compiler developers (12 of 28) are those that build Ada compilers as their primary business activity. They build compilers (and tools) for a variety of hosts and target computers with cross-compilation support suitable for real-time and embedded applications. The second category of system vendors (16 of 28) are those that build systems and provide an Ada compiler for their hardware systems. In some cases, the system vendors have obtained a compiler from an Ada compiler developer.

During the survey, one vendor indicated that he believed that almost all the system vendors had their compilers originally developed by one of the "Ada compiler developers." It appears that these developers and at least one of the system vendors (DEC) were the commercial source of the Ada compiler technology. For example, Telesoft does about \$1 million in business a year with Cray to maintain the Ada compiler on that machine, though the compiler is marketed through Cray only. Thus, many of the system vendors are actually customers of the compiler developers, and the same compiler can in some cases be obtained from either the system vendor or the developer.

2.1.4 Compiler purchase prices range from \$249 for a PC to \$400,000 for a multi-user mainframe.

The average price for an environment is \$7500 for a network file server. For a PC, there are compilers ranging from \$249 to \$3000, depending on the number of tools provided and the power of the PC. Discounts of 20-30% are negotiable and at least two vendors provide discounts to academic users. The price of software for mainframes is the highest and also provides a richer environment than is possible for a PC or workstation. Some vendors provide monthly lease options and separate maintenance contracts. A maintenance contract with the compiler vendor includes software problems/errors fixes and product improvements in successively validated versions of the compiler.

2.1.5 Three Ada vendors support IBM business system environments.

Historically, business systems maintain corporate data bases and financial systems on IBM equipment or Instruction Set Architecture (ISA) compatible computers. The following is a profile of the tools and interface packages available for mainframes and IBM operating systems (i.e., VM/SP, VM/XA, VM/ESA, MVS/SP):

- on-line publication system
- source-code formatter
- library manager
- source-level debugger
- profiler (run-time performance measurements)
- dependency lister
- cross-reference utility
- interface to graphical data display (IBM environment)
- interface to interactive program development facility (IBM environment)
- interface to Information Management System (IMS) (IBM environment)
- standard math functions, including ISO Numerics Working Group (NUMWG)

Information provided by IBM indicates that Ada is a major product strategy and that implementing bindings and protocols to access products implementing other standards is being pushed (e.g., SQL, PHIGS, Portable Operating System Interface for Computing Environments (POSIX)). In addition to IBM, Ada compilers for IBM system environments are provided by Intermetrics and Alsys.

2.1.6 Stability and maturity characterize Ada vendors.

Most of the vendors (20 of 28) have provided validated compilers for more than 5 years. That is a relatively mature group of vendors, given that the Ada language standard dates from 1983. In the past three years, vendors have enlarged the basic compiler tool set to include design, documentation and testing tools and are now offering some bindings to FIPS and industry standards (e.g., X-Windows, MOTIF).

Information concerning the customer base was either not available or companies were unwilling to disclose these numbers. From the information obtained, there appears to be a wide variance in the size of the customer base. If the vendor (such as Alliant) makes supercomputers, then its customer base may only be a handful. Conversely, a vendor of DOS-based systems (such as Meridian) may claim a customer base of several thousand.

2.1.7 Ada compilers provide interfaces to other languages.

The pre-defined pragma interface is a feature of the Ada language that has caused concern about the uniformity of "openness" among Ada compilers. A review of recent validation documents for the 150 compilers formally tested under Ada Compiler Validation Capability (ACVC) 1.11 shows that almost all compilers support pragma interface to assembler languages of various sorts, C, and Fortran languages. Several provide an interface to Pascal and one to Cobol. The ability to import and export names and objects permits programmers to reuse non-Ada programs and operating systems or run-time services. (See Appendix B for interface names.)

2.1.8 New developments

For a handful of vendors (DEC, IBM, Verdix), there is a movement towards providing an "integrated development environment" that encompasses most phases of the software development life cycle. For the implementation phase, there are tool sets offered with the compiler. For the phases of requirements definition and design, this environment supports various off-the-shelf CASE tools. The objective is to eliminate some of the redundant work in going from requirements to design and from design to implementation. Both DEC and Verdix have either a database or "object repository" that maintains those objects,

2.2 C++ COMPILERS AND TOOLS

Eighteen out of the 22 vendors surveyed market C++ products on the commercial market as well. One of the 22 vendors sells only to other software vendors and 3 companies claimed to not have the C++ products. Table 2 is a summary of the data collected and documented in Appendix C.

Table 2. C++ Product Vendors

Company	Platform Op. System — Hardware		Price (\$)	Product Features											
				Profiler	Debugger	Assembler	ANSI-C compatible	Cross compiler	Compiler	Translator	Version control	Multiple inheritance	IDE	Class library	cfront (AT&T)
AT&T Unix Software Operation			495	✓	✓										
Borland International			150	✓	✓										
Borland International (Turbo C++)			250-5,500		✓	✓									
Comeau Computing			200												
Free Software Foundation			499-9,000												
Glockenspietel, Ltd.			1,195												
HCR Corporation			2,500												
Hewlett Packard			1,500-19,800												
HFSI (Honeywell)			495												
Intek Integration Technologies			Incl. w/O.S.												
International Business Machines			1,000-20,000												
Oaseys			895-1,700												
Oregon Software, Inc.			1,000												
Peritus International			2,698-3,698												
Saber Software			1,195												
Silicon Graphics			2,000												
Sun Microsystems, Inc.			35,000-50,000												
Taumatic			200-1000												
Zortech															

✓ = yes

X = no

blank = not available

2.2.1 C++ vendors provide programming environments composed of products that are differentiated by features and implementation strategy.

The two kinds of development products that accept C++ programs are compilers and translators. For the purpose of this survey, a compiler is a process which accepts a C++ source file as input and produces a file containing an executable or linkable program for some computer. Whereas, a translator is a process which accepts a C++ source file and produces a C language source file that can be input to a C compiler. Vendors provide compilers or translators with or without class libraries and various development tools.

Differences among C++ development products include operating systems and hardware platforms on which they function and the availability of other compatible product features. These features include operating environments and tools as well as language elements. Descriptions of some C++ product features follows.

AT&T provides a product called "cfront" which is a front end or preprocessor for C++ source code. This product has been adopted by some as a standard for the C++ language semantics. While there continues to be no formal C++ standard, several vendors offer products which began as licensed versions of "cfront" or are fully compatible with its semantics. In the survey of C++ vendors, nearly half claim such compatibility.

A feature of the C++ language is its facility for inheritance by an object from a parent object or object class. *To augment this facility, vendors may supply libraries of object classes with their products: more than half the vendors surveyed do so.* An ANSI committee, seeking to define C++ standards, plans to describe the minimum list of required classes for a class library.

An implementation of a C++ development product generally provides either command line execution or an integrated development environment (IDE) or both. An IDE is a facility to interactively connect a source editor, a compiler or translator, and a runtime environment. Usually the IDE is centered around a user interface such as a windowing capability. From the IDE a developer can maintain the connection among the edit, compile or translate, and execute processes. In other words, a user who is editing the source of a program can tell the environment to compile and execute the program. The IDE will then provide the necessary connections among the source file, the compiler, the runtime environment and any other tools or libraries needed. Most of the C++ vendors claim to have an IDE.

Inheritance of attributes by an object from another object is a feature of object-oriented programming (OOP) and the C++ language. For an object to inherit from a single parent is called single inheritance: to be able to inherit some features from one parent and some from another is called multiple inheritance. Multiple inheritance is more powerful but is considered more difficult for programmers. Users of C++ do not agree on whether multiple inheritance should be included in the language; however, most of the vendors surveyed claim to provide multiple inheritance.

Vendors provide several features which, for purposes of this survey, are called version control. Version control includes the ability to keep track of previous versions of various levels of program elements such as source code, relocatable objects, and executable modules. In the software development area version control includes archiving previous versions, providing release descriptions, controlling which modules need to be compiled before linking (called the "make" feature), etc. Nearly half the vendors surveyed claim to provide some kind of version control.

Cross compilation is a process which executes on one platform producing an executable program that runs on a different target platform. As an example, a Fortran or Pascal compiler running on a DEC VAX computer may produce output which will execute on an IBM PC. Some of the vendors surveyed claimed to provide cross compilers.

C++ compilers accept source program input which adheres to some description of C++ syntax and semantics. A subset of C++ is some version of the C language, but not necessarily ANSI C. A feature of a C++ compiler is its ability to accept and correctly compile any source file which complies with the ANSI C standard. Most vendors surveyed claim to be ANSI C compatible.

A C++ development product may provide the capability to use other languages in several ways. The product may allow instructions in another language, usually assembler, to be included within the source file along with the C++ statements. In C++ this capability is called in-line code. Another way other languages can be used is by providing a way to link the output of another compiler or assembler with the output of the C++ compiler. In the DOS product world it is not uncommon for a vendor to provide such compatibility for some of its own products and some limited number of other products. In addition, many vendors include assemblers with their C++ products to provide programmers the ability to develop their own additional functions. This last case seemed to be most common among the vendors surveyed since about half claim to provide an assembler with their products.

Many vendors provide debugging tools. A profiler is a more advanced debugger which provides a link between an executing program running under debug mode and the source statements from which each instruction came. Most vendors provide some form of debugger; a few claim to have profilers.

2.2.2 The majority of C++ products are for PCs and workstations.

The largest number of product offerings are for IBM PC-compatible systems running DOS and workstations running UNIX. For several other platforms there are individual offerings by platform vendors and by third party suppliers, such as products that run on VAX/VMS from Digital Equipment Corporation and Bull/GCOS from Honeywell.

The large mainframe manufacturers are not yet offering C++ for their systems. Thus, C++ compilers and translators are only available on small multi-user systems (e.g., AT&T B2).

2.2.3 Most vendors are software distributors who have recently entered the market.

C++ development products, like Ada products, are available from both computer vendors and third party software vendors. The clear majority of currently available products are from software vendors. However, several computer companies have development efforts underway. Some may develop their own products. Others are prone to license existing products from compiler development companies. Most vendors claim to have delivered their C++ development product within the past two years. About half of those have been on the market for a year or less.

2.2.4 Purchase prices range from \$150 to \$20,000 for PC's and small multi-user systems.

With most software products like compilers, prices vary with the category of platform. In general, products divide along the lines of PC compatibles, workstations, and shared systems such as minicomputers and mainframes. This appears to hold for C++ development products. Products which run under DOS on PC compatibles are typically priced under \$500. Workstation products tend to be under \$2000. Some products for small, multi-user systems are priced up to \$20,000. These prices tend to be in line with prices of other language compilers for the same platforms.

2.2.5 Efforts are being organized to develop a C++ standard for the language and the class library.

The companies are currently working on establishing ANSI and ISO standards for C++ are listed in Appendix D. These standards will be in two areas, the language and the class library. Although the participants represent many companies and the committees are currently active, adoption of a standard is not expected in the immediate future. At present the committee appears to have the beginnings of a working document for the language but may not have begun to construct one for the library.

2.2.6 Vendors of low cost C++ development products have a relatively large customer base.

Claims of installed base vary from very few to a high of around 350,000. These figures were not available from most vendors. The ones that were seem to be estimates and may not be accurate. There is, however, a trend which tends to indicate substantial sales of at least two products for DOS

systems, Zortec C++ with 200,000 copies and Borland C++ with 350,000 copies, as well as some considerable activity in the workstation market. The estimated installed base figures show both interest by the development community and enough sales to indicate acceptance of the products. The apparent flurry of computer companies to provide C++ products for their systems indicates some acceptance of C++ as a programming language.

2.2.7 C++ products provide interfaces to other software implemented in C or assembler.

External interfaces to other software products are available from some vendors. In particular, vendors tend to provide access to an assembler and in some cases other language interfaces. Other accesses are available to data base management systems and user interfaces like X-windows. It appears that almost any product available to a vendor's C language product is also available to its C++ product.

2.2.8 New developments target mainframe hardware systems.

Although C++ development products are now on the market for PCs, workstations and shared systems, many more are on the way. As with most previous languages, computer vendors are anxious to provide C++ products which will take advantage of their own platform configurations. C++ projects are now underway at IBM, Honeywell, Hewlett-Packard, and many other companies. Expectations are that the language will be available for most major platforms in the United States.

2.3 AVAILABILITY OF Ada AND C++ TRAINING AND EDUCATION

In preparing this analysis, the following sources were used:

- Ada Software Engineering Education and Training (ASEET) Data Base
- The Journal for Object-Oriented Programming
- Contacts within the academic and DoD areas

Appendix E includes the updated ASEET database and sources for C++ training. The database includes the types of courses taught, and when available the cost and a point of contact.

2.3.1 There are more sources of training and/or education for Ada usage than for C++.

Since 1983, when Ada was adopted as an ANSI standard, the AJPO has emphasized the need for Ada education and training within the DoD, industry, and academia. One of the first initiatives was to encourage the creation of numerous Ada courses by both government and commercial organizations. Today, Ada training is available throughout the country, at least one university in every state teaching Ada. All three military academies offer Ada in their computer courses. We were not able to find any DoD facilities that taught C++; however, we have been told that the Naval Postgraduate School does use C++. In fact, most said they used Ada when teaching object-oriented design. The results of the survey on C++ in the universities is incomplete since most of the time was spent gathering information from C++ training vendors. Ada compiler vendors provide training for system designers and programmers in a classroom setting or as self-study books and software.

Recent programmer interest in C++ parallels some of the developments of object-oriented system design methods and object-oriented data base products. Object-oriented programming (OOP) is an engineering technique used to solve problems that can be expressed in terms of objects, classes of objects, inherited properties, and state data. The superiority of OOP for all types of systems is yet to be demonstrated but it is a convenient solution when the environment is based upon UNIX and C. On the other hand, Ada is being used by computer scientists and programmers to implement systems that require solutions to a range of problems (i.e., temporal, function, and structure). See Appendix F for discussion of design paradigm needs.

Table 3. Sites Teaching Ada and C++ Listed by State

State	Ada Univ	Ada-DoD	Ada Commercial	C++ Univ	C++ Commercial
Alabama	7	-	-	-	-
Alaska	2	-	-	-	-
Arizona	3	-	-	-	-
Arkansas	-	-	-	-	-
California	19	-	2	1	6
Colorado	5	1	-	-	1
Connecticut	6	-	-	-	-
Delaware	-	-	-	-	-
Florida	11	-	1	1	-
Georgia	7	1	-	-	-
Hawaii	2	-	-	-	-
Idaho	-	-	-	-	-
Illinois	7	1	-	-	-
Indiana	6	-	1	-	-
Iowa	4	-	-	-	-
Kansas	4	-	-	-	-
Kentucky	4	-	-	-	-
Louisiana	3	-	-	-	-
Maine	1	-	-	-	-
Maryland	6	1	4	1	-
Massachusetts	5	-	2	-	5
Michigan	7	-	-	-	2
Minnesota	2	-	-	-	-
Mississippi	4	1	-	-	-
Missouri	6	-	-	-	-
Montana	-	-	-	-	-
Nebraska	-	1	-	-	-
Nevada	-	-	-	-	-
New Hampshire	-	-	-	-	-
New Jersey	5	-	1	-	3
New Mexico	4	-	-	-	-
New York	11	1	-	-	2
North Carolina	3	-	-	-	-
North Dakota	3	-	-	-	-
Ohio	10	2	-	-	1
Oklahoma	6	-	-	-	-
Oregon	-	-	-	-	1
Pennsylvania	12	-	-	-	1
Rhode Island	1	-	-	-	-

- indicates unknown; note results on C++ in Universities is incomplete due to time constraints.

Table 3. Sites Teaching Ada and C++ Listed by State (continued)

State	Ada Univ	Ada-DoD	Ada Vendors	C++ Univ	C++ Vendors
South Carolina	1	-	-	-	-
Tennessee	7	-	-	-	-
Texas	14	1	2	-	2
Utah	4	-	-	-	-
Vermont	1	-	-	-	-
Virginia	6	2	2	-	-
Washington	3	-	-	-	-
West Virginia	7	-	-	-	-
Wisconsin	2	-	-	-	-
Wyoming	-	-	-	-	-
Washington, D.C.	5	1	1	1	-

- indicates unknown; note results on C++ in Universities is incomplete due to time constraints.

2.3.2 There is some disparity between Ada and C++ training providers.

In addition to university and compiler vendor courses, there are several Ada education and training vendors who specialize in teaching software engineering with Ada. The courses vary from two-to-four hour introduction courses for managers to a one-or-two week long intensive Ada programming course. Some vendors charge a flat fee (\$10,000) and limit the course to 12-20 people, while others charge per student (\$1100/each). These courses may be taught either at the customer's site or at a public seminar or at the vendor's site. Most of the hands-on workshops do limit the number of participants, while a course such as the executive overview is left open.

Most of the listings for C++ were independent training vendors. Many are small consulting firms that offer training only on the customer's site. The average course is five days long and includes some type of hands-on lab. Most claim to provide hands-on for any type of platform for which C++ products are sold, although one firm stated that they only teach C++ on the Macintosh (Arbor Intelligent Systems, Inc.). The cost of these courses varies and does not include the travel and living expenses of the instructor. The student cost ranges from \$695/each for a two-day course to \$1,200/each for a five-day course to a set price of \$9,900 for a four-day course with a maximum number of 20 students. Vendors always indicated that they could develop or customize a C++ for

their customer if needed. Most of the companies are small (i.e., two to five people) and some of the vendors listed in the November-December 1990 issue of *Journal of Object-Oriented Programming* appear to have already gone out of business.

2.4 STATUS OF CASE TOOLS.

From a list of 200 commercial vendors of products, informally known as CASE tools, data was collected on 155 with 44 being classified by our definition as CASE tools. Tools that support particular design or analysis methodologies are not usually influenced by the choice of implementation language, but the majority of these CASE tools is not completely language independent because most generate code. Appendix G provides ten tables that consolidate descriptive information about CASE tools. Appendix H documents, in more detail, the information collected on the 44 CASE tools. The following findings indicate the status of CASE tools.

2.4.1 Structured Analysis (SA) and Structured Design (SD) are the most widely supported software development methods, although increasing support for object-oriented approaches is evident.

Methods for software design and then analysis fall into two groups: process-oriented methods to support the development of information systems, and behavior- or state-oriented methods for process-control systems. This distinction has blurred as the most popular, process-oriented methods, SA and SD, have been augmented with techniques for expressing behavior. In the last few years, an object orientation to software development has evolved.

Over 65% of CASE tools provide support for SA and SD and three quarters of these include the augmentations for expressing behavior. Over one quarter support OOD, and a quarter of these also support OOA. Nearly a fifth support both SA/SD and object-oriented approaches. More details on the method support offered by particular CASE tools are presented in Appendix G, Table 2. Information on operating environments, breadth of use, report generation, adaptability, etc., can be found in Appendix G, Table 3.

2.4.2 CASE tools for the development of information systems differ from those that support the development of other types of software.

Roughly half as many CASE tools are intended for the development of information systems as for other types of software systems (for example, real-time and process control systems). The distinction between these two groups of CASE tools is evidenced in several ways. For example,

only those CASE tools intended for the development of information systems typically support data base design and, in the few cases where prototyping is provided, it supports user interface (forms and screen) design. Again, only information system-oriented CASE tools typically support business analysis and planning activities. On the other hand, CASE tools in the second group are more likely to support simulation and requirements tracing activities and to provide the users with a selection of development methods.

2.4.3 Support for CASE tool customization is limited.

Over 65% of CASE tools provide free-form or customizable graphics. Tailoring of the underlying development methods is much less frequent and generally requires the user to develop new code. Three vendors market tools that support rule-based customization of their CASE tool, two offer tools specifically intended to the user screens or menus, and one markets a meta-CASE tool that can be used to develop CASE software. See Table 4, Appendix G.

2.4.4 The majority of CASE tools support source code generation.

Virtually all CASE tools generate some type of code, though those that support the development of information systems may only generate data handling or user interface code. The language(s) generated varies, depending on the type of CASE tool considered:

- CASE tools supporting the development of information systems either include tool components that generate code or link with independent application generators for this function. In the first case, code generators typically produce Cobol and C, and the introduction of Ada and C++ has had little impact. In the second case, application generators (see Table 5, Appendix G) are traditionally devoted to the production of Cobol; although no application generators that support Ada have been identified, some support for C++ is evident.
- Code generation for other types of software systems (e.g., process control, embedded, real time) favors (in descending order) C, Ada, Pascal, Fortran, C++, PL/I, and Jovial. The entire source code is not necessarily generated and some tools provide user-customizable templates that govern this partial generation. Support for C++ is one of the most frequently cited planned tool enhancements and C++ is expected to follow Ada in popularity within the next 18 months.

2.4.5 C is being used by CASE tool developers.

In terms of tool implementation language, the majority of CASE tools are implemented in C. However, over 20% of the vendors already have, or plan to, reimplement their products in C++. Fewer tools have been developed or reimplemented in Ada. Reasons for using C or C++ for tools may be based on economics. For example, C compilers are relatively inexpensive (no validation costs, smaller language, etc.) and existing C interfaces to windows and UNIX facilities reduces effort.

2.4.6 Workstations are the favored hardware platform.

The majority of CASE tools operate on workstations and are capable of supporting multiple concurrent users over a network. Roughly two thirds are also supported on PCs, and roughly one third are also supported on mainframes. PCs and mainframes are rarely the only operating platform. The dependence of these tools on the underlying programming support environment is restricted to a language compiler and related language-sensitive tools.

2.4.7 CASE vendors say they support open systems and interoperability.

Roughly half of the CASE tool vendors state that their tools exist in an open environment. Many vendors further support interoperability by conforming with the de facto industry standard X-Windows. Support for the CASE Data Interchange Format (CDIF) (Electronics Industry Association) standard is less prevalent but increasingly apparent.

2.4.8 CASE vendors offer relatively mature products.

While six tools are major extensions or reworks of products developed in the late 1970s and early 1980s, roughly half of the currently marketed CASE tools were introduced between 1984 and 1987. Tools continue to be introduced. The initial focus on support for development of information systems has gradually changed and the majority of recent offerings support the development of real-time software systems.

Some vendors report the number of licenses they have sold, whereas others measure usage in terms of the number of installations. Until recently, information system-oriented CASE tools have been the most widely used, with installations and licenses numbering in the thousands. Over the last few years, increased awareness of software engineering and, perhaps, better marketing of

CASE products have led to wide usage of CASE tools supporting the development of other types of software systems. Table 1 (Appendix G) lists product introduction date and estimated customer base.

2.4.9 Future Trends

Bridges between CASE tools are increasingly used to extend the scope of software development activities supported by particular tools. Roughly one third of the CASE tools have vendor-supported bridges that exploit the capabilities of other CASE tools. While the majority of current bridges only support a one-way transition between tools, some bi-directional bridges are beginning to appear. In addition to allowing the use of specialized tools as required, these bridges can facilitate the reuse of software products developed using different tools. Table 6 (Appendix G) identifies the available bridges.

2.4.10 CASE tools continually increase their coverage of software development activities.

Early CASE tools focused on software analysis and design activities. Initial extensions focused on earlier development activities and led to the provision of requirements traceability capabilities. Roughly half the CASE tools provide this capability, the majority of which do so as an integral part of the tool. Another area of early extension was the provision of system specification and simulation capabilities. Roughly one third of the tools support system simulation, usually via a separately purchasable option.

In the last few years, vendors have been introducing support for reverse engineering to facilitate software maintenance and, to some extent, reuse. Roughly half the CASE tools have this capability, and several more expect it within the next 18 months. Although usually provided as an integral part of the CASE tool, reverse engineering tools are also available as separately purchasable options and as stand-alone tools. Roughly equivalent numbers of tools are available for reverse engineering of Ada and C++. See Table 7 (Appendix G).

A few CASE vendors are starting to support software testing. This capability is generally provided through separately purchasable options, primarily for Ada and C code. The stand-alone testing tools identified. See Table 8 (Appendix G), predominantly support Ada, although one vendor does offer support for C++.

2.4.11 CASE vendors talk about migration to repositories.

Early CASE tools used a data dictionary to store definitions of the various data flows, processes, data stores, etc., specified as part of software analysis and design activities. A repository, in simple terms, is a central database that contains all information pertaining to a development effort. It provides better support for information sharing among team members, tool integration, and new development paradigms such as Boehm's risk-driven approach. An object-oriented repository, in particular, provides the flexibility to facilitate CASE customization and extension. All CASE tools introduced in the last couple of years employ repositories. A significant number of early tools have recently switched to a repository.

2.4.12 Integration frameworks are increasingly preferred as a mechanism for integrating project management and similar tools with CASE tools.

Repositories have led to the development of integration frameworks that provide a consolidation of the underlying information architecture to offer a disciplined approach to tool integration. They allow CASE tools to be integrated into a base set of capabilities supporting, for example, resource management, change management, and access to multiple databases. Identified repositories are listed in Table 9 (Appendix G).

IBM's announced integration framework, *AD/Cycle*, is expected to have a significant impact on CASE tool evolution, and the majority of vendors plan to ensure compatibility with *AD/Cycle* as it becomes available.

2.5 CONCLUSIONS

Conclusions based on the limited scope of the survey and analysis of findings are:

- Ada compilers are available for PCs, workstations, and mainframes, including the mainframe computers most often used for large business applications. C++ products are available for PCs and some multi-user engineering workstations but not in general for mainframes.
- There is stability and maturity among Ada compiler vendors with the majority of Ada companies providing validated compilers for five or more years. The majority of C++ vendors have entered the market during the last two years although many have provided C compilers for many years.

- There is considerable variability among C++ products in the language features they support, the libraries provided, and strategy for language support. The standardization effort for C++ and libraries is just beginning. The Ada 9X standard with its object-oriented programming support is expected to be adopted by ANSI and ISO by the time the C++ standardization effort results in an adopted standard.
- The wide availability of Ada training and education reflects DoD efforts to promote Ada as a way to teach software engineering methods. Currently, Ada is being taught and used in university computer science departments. Most Ada compiler vendors are a source of training materials and instruction while C++ training and education is in limited supply.
- CASE tools exist to support both Ada and C++. Structured analysis and structured design are the most widely supported development methods but object-oriented design and analysis are just entering the picture. CASE tools marketed for business applications do not contain features such as requirements tracing and simulation and choices among design paradigms. Future plans among CASE and compiler vendors call for an integration framework so that tools can be distributed as commercial-off-the-shelf products for a variety of platforms.

3. ACRONYMS

4GL	Fourth Generation Language
ACM	Association for Computer Machinery
ACVC	Ada Compiler Validation Capability
ADPE	Automated Data Processing Equipment
AI	Artificial Intelligence
AJPO	Ada Joint Program Office
ANSI	American National Standards Institute
ASEET	Ada Software Engineering Education and Training
C3I	Command, Control, Communications, and Intelligence
CAD	Computer-aided Design
CASE	Computer-aided Software Engineering
CDIF	Computer-aided Software Engineering (CASE) Data Interchange Format
COTS	Commercial Off-the-Shelf
DEC	Digital Equipment Corporation
DoD	Department of Defense
FIPS	Federal Information Processing Standard
GSA	General Services Administration
IDA	Institute for Defense Analyses
IDE	Integrated Development Environment
IMS	Information Management System
ISA	Instruction Set Architecture
ISO	International Organization for Standardization
MF	Main Frame
n/a	not available
NIST	National Institute of Standards and Technology
NUMWIG	Numerics Working Group, International Organization for Standardization
OOA	Object-oriented Analysis
OOD	Object-oriented Design
OOP	Object-oriented Programming

PC	Personal Computer
PHIGS	Programmer's Hierarchical Interactive Graphics
POSIX	Portable Operating System Interface for Computing Environments
R&D	Research and Development
RISC	Reduced Instruction Set Computer
SA	Structured Analysis
SD	Structured Design
SDIO	Strategic Defense Initiative Office
SIGAda	Special Interest Group, Ada
SQL	Structured Query Language
WS	Work Station

Appendix A -
Data Sheets for Ada Compiler Vendors

1. AETECH - James Dorman - (619) 755-1277

Compilers:

- a. IntegrAda 386 5.1.0
- b. IntegrAda 5.1.0 POSIX
- c. IntegrAda Posix 5.1.0

Products:

- a. IntegrAda
 - (1) MS-DOS \$ 795
 - (2) Interactive Unix Version 2.1 \$1,995
 - (3) SCO/Unix Version 3.2 \$1,995
 - (4) SCO/Xenix \$1,995
- b. Ada Software Development Toolset
 - (1) MS-DOS \$ 495
 - (2) Interactive Unix Version 2.1 \$ 895
 - (3) SCO/Unix Version 3.2 \$1,995
 - (4) SCO/Xenix \$1,995
- c. Assembler
 - (1) MS-DOS \$ 395
 - (2) Interactive Unix Version 2.1 \$ 895
 - (3) SCO/Unix Version 3.2 \$ 795
 - (4) SCO/Xenix \$ 795
- d. AdaScope Debugger (MS-DOS only) \$ 595
- e. AdaGraphics (MS-DOS only) \$ 695
- f. Training & Reference Module
 - (1) MS-DOS \$ 295
 - (2) Interactive Unix Version 2.1 \$ 695
 - (3) SCO/Unix Version 3.2 \$ 695
 - (4) SCO/Xenix \$ 695
- g. HyperARM (MS-DOS only) \$ 75
- h. Ada Training Environment (MS-DOS only) \$ 895
- i. Academic IntegrAda (MS-DOS only) \$ 249
- j. AdaEval (MS-DOS only) \$1,295
- k. Ada Instructor Courseware (MS-DOS only) \$ 399
- l. Ada Workstation Environment (Telesoft compiler)
 - (1) Interactive Unix Version 2.1 \$ 995
 - (2) SCO/Unix Version 32. \$ 995

(3) SCO/Xenix	\$ 995
m. Programmer's Deluxe Package (MS-DOS)	\$2,495
— IntegrAda compiler	
— Ada Software Development Toolset	
— Assembler	
— AdaGraphics	
— "On-Line" Training & Reference Module	
— HyperARM	
n. Programmer's Special Package	\$1,195
— IntegrAda	
— Ada Software Development Toolset	
(1) MS-DOS	\$1,195
(2) Interactive Unix Version 2.1	\$2,495
(3) SCO/Unix Version 3.2	\$2,495
(4) SCO/Xenix	\$2,495
o. Student Package (MS-DOS only)	\$ 399
— Academic IntegrAda	
— Training & Reference Module	

Maturity: Since 1988

Education/Training: "Ada Training Environment" product. On-site training also.

Other languages: No; Only bindings to XWindows, PHIGS.

Customer Base: AF Desktop III contract

2. Aitech Systems Ltd. - Eric Gries

Compilers:

a. AI-ADA/88K Version 2.4

Products:

Maturity: Since 1988

Education/Training:

Other languages: Assembler for targets; no C++

Customer Base:

3. Alliant Computer Systems - Paul Rubin - (508) 486-4950

Compilers:

a. Alliant FX/Ada-2800 Compiler, Version 1.0

b. Alliant FX/Ada Compiler, Version 2.3

Products:

(1) FX/Ada Development System

- compiler
- symbolic debugger
- library maintenance utilities
- runtime system
- "make" utility
- link preprocessor
- math libraries
- disassembler utility
- source code formatter utility
- vi editor

Prices:

- a. FX40 - \$15,000
- b. FX80 - \$25,000
- c. FX800 - \$25,000
- d. FX2800 - \$50,000 - \$75,000

Maturity: Since 1987 (FX8)

Education/Training: No

Other languages: ANSI standard C and Fortran

Customer Base: 3 customers; FX40 - 25 users

4. Alsys

Compilers:

- a. AlsyCOMP_016
- b. AlsyCOMP_026 Version 5.3
- c. AlsyCOMP_030
- d. AlsyCOMP_031
- e. AlsyCOMP_042, Version 5.3
- f. AlsyCOMP_026, Version 1.82
- g. AlsyCOMP_025, Version 1.83
- h. AlsyCOMP_046, Version 5.3
- i. AlsyCOMP_004, Version 5.3
- j. AlsyCOMP_050, Version 5.3
- k. AlsyCOMP_002, Version 5.3
- l. AlsyCOMP_005, Version 5.3

- m. AlsyCOMP_035, Version 5.3
- n. AlsyCOMP_016, Version 5.1
- o. AlsyCOMP_003, Version 5.1
- p. AlsyCOMP_037, Version 5.2
- q. AlsyCOMP_037, Version 5.3
- r. AlsyCOMP_012, Version 5.3
- s. AlsyCOMP_036, Version 5.3
- t. AlsyCOMP_015, Version 5.3
- u. AlsyCOMP_017, Version 5.2
- v. AlsyCOMP_017, Version 5.3
- w. AlsyCOMP_018, Version 5.2
- x. AlsyCOMP_006, Version 5.3
- y. AlsyCOMP_023, Version 5.3
- z. AlsyCOMP_011, Version 5.3
- aa. AlsyCOMP_034, Version 5.2
- ab. AlsyCOMP_043, Version 5.3
- ac. AlsyCOMP_034, Version 5.1

Products:

- a. FirstAda - Ada Software Development Environment for DOS. Price: \$1,815
- b. AIX 370 Ada Compilation System and Toolset. Price: \$37,800 - 126,000 (depending upon cpu power)
- c. Ada Development Environment 680x0 System. Price: \$25,000
- d. 386 DOS Ada Software Development Environment. Price: \$2,995
- e. 486 DOS Ada Software Development Environment. Price: \$2,995
- f. Ada Software Development Environment - Macintosh. Price: \$940
- g. Ada Software Development Environment for 68k UNIX Workstations. Price: \$4,495
- h. Ada Software Development Environment for 386 LynxOS. Price: \$7,500
- i. Ada Software Development Environment - Sun4 workstation. Price: \$7,500
- j. RS/6000 Ada Software Development Environment. Price: \$6,000
- k. Ada Compilation System and Toolset for DECstation and MIPSworkstations. Price: \$7,500
- l. Ada Software Development Environment Targeted to the Inmos Transputer. Price: \$30,000 - 65,000
- m. VAX/VMS to MIPS Ada Cross-Compilation System and Toolset. Price: \$30,000 - 65,000
- n. Alsyes AdaProbe/ICE. Price: \$5,000 (separate)

o. Alsys AdaTune. Price: \$1,500 (w/environment)

p. Alsys Ada Connect/TCP-IP. Price: \$5,000 (separate)

Maturity: Since 1984

Education/Training:

Other languages: No

Customer Base:

5. Apollo

Compilers: Compiuler provided by ALSYS

a. Apollo DN10000, Domain/OS

b. Apollo DN3500, Domain/OS

Products:

Maturity: Since 1987

Education/Training:

Other languages:

Customer Base:

6. Concurrent Computer Corp.

Compilers:

a. C3 Ada, Version 0.5

b. C3 Ada, Version 1.1v

c. C3 Ada Version R03-00

d. C3 Ada Version 1.0v

e. C3 Ada Version 1.1v

Products: In-house compiler for applications, hardware and software systems.

Maturity: Since 1986

Education/Training:

Other languages:

Customer Base:

7. CONVEX Computer corp.

Compilers:

a. CONVEX Ada, Verison 2.0

Products: Compiler used in-house, sold as part of a total system.

Maturity: Since 1988

Education/Training:

Other languages:

Customer Base:

8. DDC International

Compilers:

- a. DACS VAX/VMS to 80386 PM Bare Ada Cross Compiler System, Version 4.6
- b. DACS80386 UNIX V Ada Compiler System, Version 4.6
- c. DACS Sun3/SunOS Native Ada Compiler System, Version 4.6
- d. DACS VAX/VMS to 80186 Bare Ada Cross Compiler System with Rate Monotonic Scheduling, Version 4.6
- e. DACS VAX/VMS to 80386 Bare Ada Cross Compiler System with Rate Monotonic Scheduling, Version 4.6
- f. DACS VAX/VMS to 80186 Bare Ada Cross Compiler System, Version 4.6
- g. DACS 80386 DMS/OS Ada Compiler System, Version 4.6
- h. DACS VAX/VMS Native Ada Compiler System, Version 4.6
- i. DACS VAX/VMS to 68020 Bare Cross Compiler, Version 4.6

Products:

- a. DDC-1 Ada Compiler System (DACS)
 - Native mode compiler
 - DACS Ada Symbolic Debugger
 - Ada Program Library Utility
 - DACS Downloader
- b. DACS-80860 Ada Cross Compiler System (VAX Host)
 - DACS-80860 Cross Compiler
 - DACS-80860 Ada Symbolic Debugger
 - DARTS (DDC-I Ada Run-Time System)
 - DACS PLU (Program Library Utility)
 - DACS Linker
 - DACS Mathematics package
 - DACS Recompile
 - DACS Disassembler
- c. DACS-386/UNIX Tool Set
 - Ada Compiler
 - Program Library Manager
 - Disassembler

- Ada Symbolic Debugger
- d. DACS-AIX/PS2 Tool Set
 - Ada Compiler
 - Program Library Manager
 - Disassembler
 - Ada Symbolic Debugger

Maturity: Since 1986

Education/Training:

Other languages:

Customer Base:

9. Digital Equipment Corp. - Pat Bernard

Compilers:

- a. VAX Ada Version 2.2

Products: (Prices are for VAXstation 3000/4000 single-cpu)

- a. VAX Ada

- Ada compiler
- Ada program library manager
- VMS Ada run-time library
- Ada library of predefined units
- VMS Debugger support

Price: \$5,160 (VAXstation 3000/4000 single cpu)
(max \$331,200 for VAX 9000 with cluster license)

- b. VAXELN Ada

- VAXELN Ada run-time library
- VAXELN Remote Debugger support

Price: \$1,540

- c. VAX DEC/Code Management System (CMS)

Price: \$1,960

- d. VAX Language-Sensitive Editor (LSE) - source code analyzer

Price: \$1,280

- e. VAX DEC Model Mangement System (MMS)

Price: \$480

- f. VAX DEC/Test Manager

Price: \$1,810

- g. VAX Performance and Coverage Analyzer (PCA)

Price: \$1,590

h. VAXset (VAX Software Engineering Tools)

- VAX DEC/Code Management System (CMS)
- VAX Language-Sensitive Editor (LSE)
- VAX DEC/Test Manager
- VAX Performance and Coverage Analyzer (PCA)
- VAX DEC Module Management System (MMS)
- Program Design Facility (PDF)

Price: \$5,340

i. DEC FUSE (for ULTRIX) - workstation-based programming environment (supports C, Fortran, and Pascal)

- Editor
- Debugger
- Program Builder
- Call Graph Browser
- Profiler
- Cross-Referencer
- Code Management Tool

Price: \$1,500

j. CDD/Repository (Cohesion - integrated environment)

Price: To be announced in June 91

Maturity: Since 1984

Education/Training: Yes...

Other languages: not for C++; support for BASIC, C, Pascal, FORTRAN, COBOL, PL/I,

BLISS-32

Customer Base: Proprietary

10. E-Systems, Inc. - Tim Holton (813) 381-2000

Compilers:

a. Tolerant Ada Development System, Version 6.0

- has debugger, but no other tools

Prices: Not developed yet.

Maturity: Since July 90; Tolerant originally validated in 1986.

Education/Training:

Other languages: No

Customer Base: Only in-house to-date

11. Encore Computer

Compilers:

- a. APLEX Ada Compiler revision 2.3

Products: Verdix compiler

Maturity: Since 1987 (Verdix)

Education/Training:

Other languages:

Customer Base:

12. Harris

Compiler:

- a. Harris Ada 5.1

Products:

- a. Ada Compiler (w/o APSE tools)

Price: \$18,500 (usually discounted 20-30%)

- b. Harris Ada Programming Support Environment (HAPSE)

- compiler
- editor
- library manager
- link loader
- code profiler
- symbolic debugger
- optimizer
- configuration management

Price: \$30,000 (usually discounted 20-30%)

- c. HAPSE for Software Engineering (HAPSE/SE) (no longer offered)

- Harris Ada PDL
- Management Report Generator
- Documentation Generator
- Testing Assistant

Price: (\$30,000 - no longer offered)

Maturity: Since 1986

Education/Training: Courses: Ada Programming, Project Management

Other languages: C, Fortran

Customer Base: Military

13. Hewlett-Packard

Compilers:

- a. HP 9000 Series 300 Ada Compiler, Version 5.35

Products:

- a. Ada Development System (uses Alsys tools)

- compiler
- editor
- AdaProbe symbolic debugger
- AdaMake program builder
- AdaTune program analyzer
- AdaFormat source code formatter
- AdaXref cross referencer
- library management utilities
- Run-time Executive
- math library

- b. HP Ada/SoftBench (integrated development environment) adds:

- Ada Reference Manual Browser
- Program Builder
- Static Analyzer
- Development Manager

- c. Bindings to GKS, Starbase, HP-UX, SQL, Xlib, Xtoolkit, and OSF/Motif (separate)

Maturity: Since 1987

Education/Training:

Other languages: C++

Customer Base:

14. IBM, IBM Canada Ltd

Compilers:

- a. AIX/Ada 6000 Release 2, Preliminary Version

Products:

- a. IBM Ada/370

- compiler
- natural language support
- screen editor
- product information library and messages
- subsystem support
- Graphical Data Display Manager
- NUMWG standard math functions
- Interactive System Productivity Facility

- ISPF/Program Development Facility
- MVS Event Control Blocks
- Information Management System
- development support facilities
- library management tools
- cross-reference utility
- source-level debugger
- online publication library
- source code formatter
- Ada source dependency lister
- Ada profiler
- b. IBM Ada/370 Runtime Library (separate)
- c. AIX Ada/6000
 - APSE tools
 - source level debugger
 - online hypertext publications
 - integration module for Atherton Backplane
 - Bindings
 - X Windows
 - Math library including NUMWG
 - AIX NLS library
 - AIX Window Graphics Support library
 - GL Graphics Library
- d. AIX Ada Run Time Environment/6000

Maturity: Since 1986 (S/370); 1988 (AIX/RT)

Education/Training: 3 1-week courses, 6 seminars

Other languages:

Customer Base: FAA/AAS project

15. Intermetrics, Inc. - Bill Zimmerman

Compilers:

- a. (Scheduled for testing - IBM 3083, UTS)
- b. (Scheduled for testing - IBM, MVS)
- c. (Scheduled for testing - VAXstation 3100, VMS)

Products:

- a. Ada development environment
 - Compiler
 - code generator
 - Byron PDL

- SLCSE (Software Lifecycle Environment which maps code from an Ada ERA type database to commercial relational DB
- SQL interface
- Adaview Debugger

b. InterTools

c. Whitesmiths

Maturity: 1986

Education/Training: Provide courses for use of tools

Other languages: C, Pascal, Lisp, Modula, Fortran, CMS-2

Customer Base: proprietary

16. Irvine Compiler

Compilers:

- a. (Scheduled for testing - HP 300/400 series, UNIX)
- b. (Scheduled for testing - HP 800/700 series, UNIX)
- c. (Scheduled for testing - ISI Optimum V, Unix)
- d. (Scheduled for testing - Sun, SunOS)
- e. (Scheduled for testing - VAX, VMS)

Products:

- a. ICC Ada Software Development and Test Environment (HP 9000/ Series 300/400/700, SPARC, SUN3 self-hosting)
 - compiler
 - optimizer
 - archiver
 - compilation system librarian
 - debugger
 - language sensitive editor

Prices: (for self-hosting compiler systems)

- (1) HP9000/700 (single user HP Risc) \$ 5,000
- (2) HP9000 series 300/HP-UX v6.2 \$ 5,000
- (3) HP9000/800 (below 840)/HP-UX \$14,000
- (4) HP9000/800 (above 840)/HP-UX \$18,000
- (5) HP9000/700 (multi user HP Risc) \$18,000
- (6) Sun 3 / Sun OS 4.0 \$ 5,000
- (7) SPARCstation (Sun Risc) \$ 5,000
- (8) MicroVAX/VMS 4.x \$ 5,000
- (9) VAX 11/7XX VMS 4.x \$10,000

- (10) VAX8XXX/VMS 4.x \$15,000
- (11) UNIX 68000, 10, 20,30 systems --
- (12) Integrated Solutions/BSD UNIX 4.3 \$ 5,000
- (13) AT&T 3B2 / System V --
- b. ICC Ada Software Development and Test Environment (68000, 68010, 68020, 68030, i80960MC targets)
 - compiler
 - optimizer
 - archiver
 - compilation system librarian
 - debugger
 - language sensitive editor
 - assembler
 - linker
 - simulator
 - profiler
 - symbol table utility
 - disassembler

Prices:

- (1) VAX cpu (VS2000, VAXsrv 3100, VSII, VS8000, VS3xxx, VAXsrv 3xxx,MV2000, MV3100) host to Intel i80960MC \$25,000
- (2) VAX cpu (MVII, 730, MV3300, MV3400,750, 78x, MV3500, MV3600, MV3800, MV3900) host to Intel i80960MC \$50,000
- (3) VAX cpu (82xx, 83xx, 8500, 8530, 86xx, 8550, 8700, 8810) host to Intel i80960MC \$70,000
- (4) VAX cpu (8800, 8820, 8840, 8974, 8978, VAXsrv 6000, 6000 -xxx) host to Intel i80960MC \$90,000
- (5) VAX cpu (VS2000, VAXsrv 3100, VSII, VS8000, VS3xxx, VAXsrv 3xxx,MV2000, MV3100) host to 68000,680x0 \$30,000
- (6) VAX cpu (MVII, 730, MV3300, MV3400,750, 78x, MV3500, MV3600, MV3800, MV3900) host to 68000, 680X0 \$50,000
- (7) VAX cpu (82xx, 83xx, 8500, 8530, 86xx, 8550, 8700, 8810) host to 68000, 680X0 \$70,000
- (8) VAX cpu (8800, 8820, 8840, 8974, 8978, VAXsrv 6000, 6000 -xxx) host to 68000, 680X0 \$90,000
- (9) HP cpu (HP9000/300) host to 68000, 680X0 \$30,000
- (10) HP cpu (HP9000/400) host to 68000, 680X0 \$50,000
- (11) HP cpu (HP9000/800 HP-PA 1) host to 68000, 680X0 \$70,000
- (12) HP cpu (HP9000/700 HP-PA II) host to 68000, 680X0 \$90,000

Maturity: Since 1982

Education/Training: Training/Consulting at \$1000/day

Other languages: No

Customer Base: Boeing, GE, General Dynamics, Hughes, IBM, Litton, Lockheed, Loral,
McDonnell Douglas, Northrop, Rockwell, Singer, TRW

17. Meridian Software Systems

Compilers:

- a. Meridian Ada, Version 4.1

Products:

- a. OpenAda

- compiler
- editor
- linker
- make tool
- optimizer
- debugger
- utility libraries

- b. Meridian Ada

- compiler
- editor
- linker
- source level debugger
- code optimizer
- customizable developer interface
- utility libraries
- Amake (automatic recompilation and link system)
- Software Composition Manager
- embedded systems RTCL library
- host system environment libraries

- c. Professional Developer Kit (non-DOS systems)

- d. Software Composition Manager

Prices:

- | | |
|---------------------------------|---------|
| a. OpenAda DOS | \$ 299 |
| b. Meridian Ada DOS 286 | \$ 995 |
| c. Meridian Ada DOS 386 | \$1,695 |
| d. Software Composition Manager | \$ 795 |
| e. OpenAda Unix | \$1,995 |
| f. OpenAda Mac | \$ 249 |

g. Professional Developer Kit

(1) Mac	\$1,995
(2) DECstation 2100 (Ultrix)	\$2,500
(3) DECstation 3100 (Ultrix)	\$3,500
(4) DECstation 5000 (Ultrix)	\$4,500
(5) Sun 3 (SunOS)	\$3,500
(6) Sun 4 SPARC (SunOS)	\$4,500
(7) VAX (Ultrix)	not available

h. Software Composition Manager

(1) DOS systems	\$ 795
(2) DECstation 3100	\$ 995
(3) DECstation 5000	\$1,995
(4) Sun 3	\$ 995
(5) Sun 4 SPARC	\$ 995

Maturity: Since 1987

Education/Training: NSITE-Ada CBT: computer-based Ada training environment with online LRM, assignments, tests.

Level 1 license - 10 users/year \$ 3,200

Level 2 license - 25 users/year\$ 6,000

Level 3 license - 50 users/year\$ 8,000

Level 4 license - unlimited/year\$12,000

Other languages: Pascal

Customer Base: Claim to have sold 10,000 copies of Ada compilers in the last 5 months; AT&T FAA/OATS; NASA SSE; USAF RADC;

18. MIPS Computer Systems

Compilers:

a. MIPS ASAPP 3.0

b. MIPS Ada 3.0

Products:

a. Development environment on UNIX

— debugger

— editor

— libraries

Maturity: 4 years

Education/Training:

Other languages: Fortran, C, Pascal, C++

Customer Base:

19. R.R. Software

Compilers:

a. Janus/Ada 2.2.0 Phar Lap/DOS

b. Janus/Ada 2.2.0 Unix

Products:

a. Development Environment with

— debugger

— editor

— assembler

— windows

b. Pascal to Ada Translator (95%)

Maturity: 8 years

Education/Training: Videotapes, tutorial

Other languages:

Customer Base: Few thousand

20. Rational

Compilers:

a. M68020/OS-200 Cross-Development System Facility, Version 7

b. M68020/Bare Cross-Development Facility, Version 7

c. Rational Environment, D_12_24_0

Products:

a. Rational Environment (software)

— editor

— debugger

— cross referencer

— Configuration Management tool (CMVC)

— X Interface

Price: \$25,000/user

b. R1000 Development System Series 400 (hardware) (can support 10 - 12 users)

— 32M RAM

-- Networking

Price: \$36,000 with additional hard disks (+ \$12,500)

c. Rational Network Mail

Price: \$ 500/user

d. Rational Design Facility

Price: \$5,000/user

e. Rational Design Facility CASE Tool Interfaces

Price: \$2,000/user

f. Rational Publishing Interface

Price: \$1,000/user

g. Rational Cross-Development Facilities

Price: \$5,000/user

h. Performance Analysis Interfaces

Price: \$10,000/user

i. Rational Remote Compilation Facilities

Price: \$2,500/user

j. Rational Target Build Utility

Price: \$ 500/user

Maturity: Validation and first system delivered in 1985

Education/Training: \$900/person/course

Other languages: No

Customer Base: IBM, Bofors Electronics (Sweden), U.S. Army

21. Rockwell International

Compilers:

a. (Scheduled for testing - VAX 8650)

b. (Scheduled for testing - VAXstation 3100)

Products:

Maturity: DDC-based compiler validated in 1987

Education/Training:

Other languages:

Customer Base:

22. SD_SCICON - Carol Perkins

Compilers:

- a. XD Ada MC68020, Version 1.2
- b. XD Ada MIL-STD-1750A, Version 1.2
- c. XD Ada MC68000 V1.1

Products:

- a. XD Ada MC68020, Version 1.2
- b. XD Ada MIL-STD-1750A
- c. XD Ada MC68000

Development Environment (with each compiler)

- compiler
- debugger
- assembler
- formatter
- builder for generic target support
- run-time system
- emulator support
- simulator support
- CASE integration

Maturity: Original validation in 1986; First revenue shipment in June 1989 (MC68020)

Education/Training: Courses; 2-day on-site course; consulting

Customer Base: > hundred for N. America

23. Silicon Graphics

Compilers:

- a. IRIS 4D ADA 3.0

Maturity: Since 1987

Education/Training:

Other languages:

Customer Base:

24. Tartan Laboratories, Inc.

Compilers:

- a. Tartan Ada Sun Ada960MC Compiler V2.0
- b. Tartan Ada Sun/C30, Version 2.2
- c. Tartan Ada VMS/1750A, Version 2.11
- d. Tartan Ada VMS/C30, Version 2.2

e. VMS Ada960MC Compiler R1.0

Products:

a. Ada VMS 1750A Compilation System

- compiler
- “Multiple Librarian”
- runtime system
- ARTClient - Tartan Ada Runtime Client Package
- TXREF - cross reference tool
- AdaScope - source-level debugger
- Object File Utilities
- linker
- object file librarian
- format conversion utilities
- object file dumper
- Ada library with Ada packages for I/O and other facilities
- online help

b. Optional Products for the 1750A Compilation System:

- (1) Runtime Enhancement Package
- (2) Package of elementary math functions
- (3) Expanded memory support
- (4) Tartan 1750A simulator
- (5) Support for HP64000 and Tektronix 8540 emulators

c. Ada VMS C30 & Sun-3 C30 Compilation System

- compiler
- librarian
- runtime system
- ARTClient - Tartan Ada Runtime Client Package
- TXREF - cross reference tool
- AdaScope - source-level debugger
- Object File Utilities
- linker
- object file librarian
- format conversion utilities
- object file dumper
- Ada library with Ada packages for I/O and other facilities
- package of elementary math functions
- online help

d. Optional Products for C30 Compilation System:

- (1) Ada Runtime Enhancement Package

e. Ada VMS 960MC & Sun-3 960MC Compilation System

- compiler
- "Multiple Librarian"
- runtime system
- ARTClient - Tartan Ada Runtime Client Package
- AdaScope - source-level debugger
- Object File Utilities
- linker
- object file librarian
- format conversion utilities
- object file dumper
- Ada library with Ada packages for I/O and other facilities
- online help

f. Optional Products for 960MC Compilation System:

(1) Runtime Enhancement Package

g. Ada VMS 680X0 Compilation System

- compiler
- librarian
- runtime system
- ARTClient - Tartan Ada Runtime Client package
- TXREF - cross reference tool
- AdaScope - source-level debugger
- Object File Utilities
- linker
- object file librarian
- format conversion utilities
- object file dumper
- Ada library with Ada packages for I/O and other facilities
- Intrinsics: functions for access to hardware capabilities
- online help

h. Optional Products for 680X0 Compilation System:

(1) AdaScope Retargeting Kit

(2) Kernel Customization Kit

(3) Runtime Enhancement Package

Maturity: Since 1987

Education/Training:

Other languages:

Customer Base:

25. Telesoft

Compilers:

- a. (Telesoft - Cray Ada X-MP 228, UNICOS Version 5.1)
- b. (Telesoft - Cray Ada-Y-MP 1001, UNICOS Version 5.1)
- c. TeleGen2 Ada Cross Development System for SUN-3 to 68k Version 4.1
- d. TeleGen2 Ada Cross Development System for VAX to MIPS, Version 4.1
- e. (Telesoft - Cray-2 2024, UNICOS Version 5.1)
- f. TeleGen2 Sun-3 Ada Development System, Version 4.01
- g. TeleGen2 Ada Development System, Version 4.1 for SPARCSystems
- h. TeleGen2 Ada Development System for VAX/VMS, Version 3.23
- i. TeleGen2 Ada Development System, Version 1.4
- j. TeleGen2 Sun-4 Ada Development System Version 1.4

Products:

- a. TeleArcs (design and support tool)
 - Ada language sensitive editor
 - automated compilation tool
 - Ada source cross referencer and browser
 - user interface customizer
- b. TeleGen2 Ada Host Development System
 - compiler
 - library manager
 - library toolset
 - Ada execution environment
 - source level debugger
 - global optimizer
 - pretty printer
 - compilation order tool
 - cross referencer
 - source dependency lister
- c. TeleGen2 Cross Development System
 - Object Tools
 - Library Manager
 - Library Toolset
 - Ada Execution Environment
 - cross referencer
 - source dependency lister
 - pretty printer
 - compilation order tool
 - source level debugger
 - global optimizer

Prices:

- a. Sun-3 Unix Host Compiler Systems

- | | |
|---|----------|
| (1) Sun-3/50,60,80,150,160,260,270,280; SPARC SLC; | \$4,500 |
| (2) SPARC 1,1+,11,310,330; Sun-3/470,480; Sun-4/110,150,260,280; | \$ 7,500 |
| (3) SPARCstation Server 370,390 | \$ 8,500 |
| (4) SPARCstation Server 470,490; | \$ 9,500 |
| b. VAX/VMS Host Compiler Systems | |
| (1) All VAXStations/Server 3XXX, 4000-300; | \$ 4,500 |
| (2) MicroVAX 2000,3100; | 7,500 |
| (3) MicroVAX II, VAX 11/730; | \$12,600 |
| (4) MicroVAX 3300,3400; VAX 11/750,780,82XX; | \$20,100 |
| (5) MicroVAX 3500,3600,3800,3900; VAX 83XX; VAXserver
6210,6310; VAX 6210,6310; | \$25,000 |
| (6) VAX 8500,8530,86XX; | \$42,600 |
| (7) VAXserver 6220,6320,6312,6410,6420; VAX 8550,8700,8810; | \$50,900 |
| (8) VAXserver 6230,6330; VAX 6240,6340, 6350,6420; | \$68,900 |
| (9) VAX 8800,8820,8830,8840; VAXserver 6360,6430; | \$74,100 |
| (10) VAX 6440,6450,6460,8840,8842,8974; | \$79,200 |
| (11) VAX 8978,9210,9410,9420,9430,9440; | \$90,000 |
| c. TeleArcs | |
| (1) Sun-3 Unix systems - price ranges from \$1,700 - 2,600 depending on host compilation system | |
| (2) VAX/VMS systems - price ranges from \$4,000 - \$55,400 depending on host compilation system | |
| d. 4. Cray System - Compiler (and price) only obtained from Cray. | |

Maturity: Since 1984

Education/Training: Courses 1-week, \$1,250/attendee 3-day \$ 750/attendee

"Programmer's Introduction to Ada" \$1250

"TeleGen2 Use, Tuning, & Support" \$ 750

"Target Adaptation, Tools, and Tuning the TeleGen2 Compiler" \$1250

"Packaging Reusable Components in Ada" \$1250

"Tasking in Ada" \$1250

"Tasking and Real-Time Applications in Ada I" \$1250

"Tasking and Real-time Applications in Ada II" \$1250

"Design of Large Ada Programs" \$1250

Other languages: No.

Customer Base: 90% DOD; 3500-4500 customers (estimate)

26. Texas Instruments

Compilers:

- a. (TI for VAX/VMS)
- b. MIPS-Ada, Version 3.0

Maturity: scheduled for testing in 1991

Education/Training:

Other languages:

Customer Base:

27. Verdix

Compilers:

- a. VADS Data General Avilon, DG/UX 4.20, VAda-110-8080 Version 6.0
- b. VADS VAX/VMS=>386, VMS 5.2, VAda-110-03315, Version 6.0
- c. VAda-110-6161, Version 6.0.2
- d. VAda-110-6161, Version 6.0.2 BASE
- e. VAda-110-0202, Version 6.0
- f. VADS Sun3 SunOS VAda-110-1313, Version 6.0
- g. VADS IBM PS/2 AIX=> Intel 80386, VAda-110-35315
- h. VADS IBM PS/2 AIX=> 68K, VAda-110-35125, Version 6.0
- i. VADS Sun-4 SunOS, VAda-110-4040, Version 6.0
- j. VAda-110-4040, Version 6.0, BASE
- k. VADS Sun3 SunOS=> VAda-110-13125, Version 6.0
- l. VADS IBM RISC System/6000, AIX 3.1, VAda-110-7171, Version 6.0
- m. VADS HP 9000/300, HP-UX 7.0, VAda-110-1515, Version 6.0
- n. VADS Prime EXL/320, UNIX SystemV/386 3.2, VAda-110-3232, Version 6.0
- o. VADS VAX/VMS 5.2, VAda-110-0303, Version 6.0
- p. VADS VAX/VMS=>68k, VMS 5.2, VAda-110-03125, Version 6.0
- q. VADS VAX/VMS=> Intel VAda-110-03315, Version 6.0
- r. VADS VAX/Ultix=> 68k, Ultix 3.1, VAda-110-02125, Version 6.0
- s. VADS DEC-RISK=>68k, Ultix 3.1, VAda-110-61125, Version 6.0
- t. VADS IBM RISC System/6000=>68k, AIX 3.1, VAda-110-71125, Version 6.0
- u. VADS IBM RISC System/6000=>386, AIX 3.1, VAda-110-71315, Version 6.0
- v. VADS UNIX System V/386, Rel. 4, VAda-110-3232, Version 6.0
- w. VADS Sequent Balance DYNIX V3.0, VAda-110-2323, Version 6.0
- x. VADS Sun4=> 68k, SUnOS 4.0, VAda-110-40125, Version 6.0

- y. VADS Sun-4 => Sun-3, Sun OS 4.0, VAdA-110-4013, Version 6.0
- z. VADS AT&T 315 UNIX System V, Rel. 3.1, VAdA-110-5151, Version 6.0
- aa. VADS HP-9000/300=> 68k, HP-UX 7.0, VAdA-110-15125, Version 6.0
- ab. VADS Sun4 => SPARC, Sun OS 4.1, VAdA-110-40440, Version 6.0

Products:

- a. VADSSelf
- b. VADSCross
- c. VADSWorks
 - Verdex Ada Development System
 - compiler
 - debugger
 - library management system
 - runtime system
 - Wind River Systems VxWorks Real-time Network OS
- d. VADSapse
 - Verdex Ada Development System
 - Atherton Technology Software Backplane
 - X-Windows user Interface
 - configuration management and version control system
 - Ada-oriented editor
- e. VADSEdit
- f. Xlib Interface
- g. Statistical Profiler
- h. Sun Ada Development Environment
 - Verdex compiler
 - Network software Environment
 - symbolic debugger
 - XView Interface (to OpenWindows)
 - AdaVision (object-based user interface)
 - EditTool
 - DbTool (visual interface to symbolic debugger)
 - LRMTTool (online LRM)

Maturity: Since 1984

Education/Training:

Other languages: C++ "not yet"

Customer Base:

28. Wang Laboratories

Compilers:

a. Wang VS Ada Version 5.00.00

b. Wang VS Ada Version 5.00.00 BASE

Maturity: Since 1990

Education/Training:

Other languages:

Customer Base:

APPENDIX B

Ada Compiler Support for Pragma Interface (validated under ACVC 1.11)

This is a survey of validated implementations' support of pragma INTERFACE. Not all of the 160 or so implementations that have been tested under ACVC 1.11 have been analyzed, but all of those that are not included below will likely be similar to ones that are (e.g., Verdix-based or TeleSoft-based implementations have similar support, generally). All, or nearly all of the implementations provide a pragma that enables non-Ada identifiers to be specified for the name of the interfaced external subprogram or object.

>>> B001 supports INTERFACE for C & FORTRAN. Pragas INTERFACE_NAME & EXTERNAL_NAME are provided, as well as package MACHINE_CODE. NB: All verdix & Verdix-based compilers match this, with one possible difference in pragma names--"INTERFACE_NAME" vs. "INTERFACE_OBJECT" (e.g., see entry for B010, MIPS, & B014, Silicon Graphics, and B028, Convex).

>>> B002 through B007 match B001.

>>> B008 supports INTERFACE for C & assembler. Pragma EXTERNAL_NAME is also provided, to provide the external name for linkage (this differs from other implementations' "External_Name"s, which make Ada objects visible to other routines--vs. giving the name of an external object).

>>> B009 supports INTERFACE for "VMS" & assembler. Pragma EXTERNAL_NAME is also provided, to provide the external name for linkage (this differs from other implementations' "External_Name"s, which make Ada objects visible to other routines--vs. giving the name of an external object).

>>> B010 supports INTERFACE for C & FORTRAN. Pragas INTERFACE_OBJECT & EXTERNAL_NAME, are provided, as well as package MACHINE_CODE.

>>> B011 matches B010.

>>> B012 supports INTERFACE for Assembly, C, UNIX, & FORTRAN. Pragas LINK_NAME & INTERFACE_INFORMATION are provided to complement INTERFACE. Package MACHINE_CODE is provided.

>>> B013 supports INTERFACE for C & Assembler. Pragma INTERFACE_NAME is provided to complement INTERFACE.

>>> B014 through B016 match B010.

>>> B017 through B026 match B001.

>>> B027 supports INTERFACE for assembler, C, & FORTRAN. Pragmas INTERFACE_NAME & EXTERNAL_NAME, and package MACHINE_CODE are provided.

>>> B028 supports INTERFACE for C & FORTRAN. Pragmas INTERFACE_OBJECT, INTERFACE_SHARED_OBJECT, & EXTERNAL_NAME are provided, as well as package MACHINE_CODE.

>>> B029 matches B028.

>>> B030 supports INTERFACE for "ASM," presumably an 88K assembly language. Pragmas INTERFACE_PACKAGE & EXTERNAL_SUBPROGRAM_NAME are provided.

>>> B031 supports INTERFACE for C & Assembly. Here, INTERFACE is implemented with an optional (and non-language-defined!) third parameter, which may be used to specify a "link name".

>>> B032 matches B031.

>>> B033 matches B031.

>>> B034 is like B031, but also interfaces to "microsoft_c" (and "C"). Package MACHINE_CODE is provided.

>>> B035 matches B034.

>>> B036 matches B034.

>>> B037 matches B031, but also provides package MACHINE_CODE.

>>> B038 matches B037.

>>> B039 matches B010.

>>> B040 and B041 match B009.

>>> B042 supports INTERFACE for Assembler. There are a number of inter- face-related pragmas defined by the implementation: EXPORT_EXCEPTION, EXPORT_FUNCTION, EXPORT_OBJECT, EXPORT_PROCEDURE, and corresponding "IMPORT_" pragmas for each of the "EXPORT_" ones. Package MACHINE- _CODE is provided.

- >>> B043..8 support INTERFACE to various of (the App.F is general) the languages Assembler, C, FORTRAN, or Pascal. Pragmas INTERFACE_NAME, EXTERNAL_NAME, & EXPORT are also interface related.
- >>> For B044 through B048, see B043.
- >>> B049 supports INTERFACE to HP 68K Assembly, C, Pascal, & FORTRAN 77. Pragmas INTERFACE_NAME, EXPORT, & EXPORT_NAME are also provided.
- >>> B050 supports INTERFACE for "VMS"--which is an "A-code" language that is used by the compiler. Pragma INTERFACE_SPELLING is provided. The package MACHINE_CODE is provided.
- >>> B051 supports INTERFACE for at least "AS," presumably an assembly language for the 68K. Pragma INTERFACE_SPELLING is provided. The package MACHINE_CODE is provided.
- >>> B052 supports INTERFACE for C & Fortran. Pragmas INTERFACE_NAME & EXTERNAL_NAME are also provided. Package MACHINE_CODE is provided. (But for "I..._NAME" vs. "I..._OBJECT", this matches B039.)
- >>> B053 supports INTERFACE for Fortran, and probably other languages, although this is not explicitly stated. I remember a dispute from DEC in which the presumed bogus language name "ZZZZZ" was accepted: the DEC implementation made some sort of general interface when the name wasn't recognized. There are a number of interface-related pragmas defined by the implementation: EXPORT_EXCEPTION, EXPORT_FUNCTION, EXPORT_OBJECT, EXPORT_PROCEDURE, EXPORT_VALUED_PROCEDURE, and corresponding "IMPORT_" pragmas for each of the "EXPORT_" ones.
- >>> B054 matches B053.
- >>> B055..9 support INTERFACE for Assembler, Ada, & C (the use of "Ada" isn't explained in App.F). Pragma INTERFACE_NAME is a complement.
- >>> B056 through B059 match B055.
- >>> B060 through B063 likely match B031--there was no App.F for these.

- >>> B064 supports INTERFACE for "occam." It also provides the pragma INTERFACE_NAME.
- >>> B065 matches B064.
- >>> For B066 through B070, see B043.
- >>> B071 supports INTERFACE for "Assembler." It also provides pragmas INTERFACE_NAME, EXTERNAL_NAME, & EXPORT--the latter two enabling Ada objects to be visible to external routines.
- >>> B072 matches B071.
- >>> B073 does not support INTERFACE, but violates 2.8(8) in providing an implementation-defined pragma LIBNAME with a similar function!
- >>> B074's App.F doesn't explicitly describe INTERFACE, but it implies support for "ASM86"--Intel assembly language? There is extensive text the use of MACHINE_CODE. B074 offers pragmas INTERFACE_SPELLING & EXTERNAL_NAME.
- >>> B075's App.F doesn't explicitly describe INTERFACE, but one can see e.g.s of support for "C86"--a version of C. There is extensive text the use of MACHINE_CODE, so one might guess that it's expected that machine-code insertions are used vice interfacing to assembler. B075 offers pragmas INTERFACE_SPELLING, EXTERNAL_NAME, and SHARED_DATA --this last being used to place static package data in a shared data segment for use by other programs.
- >>> B076's App.F doesn't describe its support of INTERFACE; apparently, interface to "AS"--which might be a mnemonic for Sun/68K assembler-- is supported ("AS" was macro \$INTERFACE_LANGUAGE's value). Package MACHINE_CODE is supported.
- >>> B077 through B079 match B074.
- >>> B080 matches B042.
- >>> B081 supports INTERFACE for assembler ("ASM"). Complementary (and needed, for interface effect!) pragmas IMPORT_FUNCTION, IMPORT_OBJECT, IMPORT_PROCEDURE, & corresponding "EXPORT_" ones are also provided.

>>> B082 matches B081, but has the additional complementary pragma `IMPORT_VALUED_PROCEDURE` (with no corresponding `EXPORT_` pragma).

>>> B083 matches B082.

>>> B084 does NOT support `INTERFACE` (the Rational R1000 is pure Ada!).

>>> B085 supports `INTERFACE` for assembler, C, & FORTRAN. Pragma `LINKNAME` is provided.

>>> B086 supports `INTERFACE` for C. Pragma `INTERFACE_NAME` is provided.

>>> B087 supports `INTERFACE` for "MASM". Pragma `INTERFACE_NAME` is provided.

>>> B088 matches B087.

>>> B089 matches B086.

>>> B090 supports `INTERFACE` for assembly, C, FORTRAN, & Pascal. Pragmas `INTERFACE_INFORMATION` & `LINKNAME` are provided. (`LINKNAME` is provided solely for compatibility with other TeleSoft compilers that have it but no pragma `INTERFACE_INFORMATION`.) Package `MACHINE_CODE` is provided.

>>> B091 supports `INTERFACE` to "assembly"/"assembler", & Fortran (the first two presumably being synonyms). Pragma `INTERFACE_INFORMATION` is also provided, with parameters `Name`, `Link_name`, `Mechanism`, `Parameters`, & `Clobbered_regs`. (It is interesting--irksome, to this reviewer--to note that the macro `$INTERFACE_LANGUAGE` has the value "C": either the value is wrong, or else App.F has omitted one language.)

>>> B092 matches B091.

>>> B107 supports `INTERFACE` for assembler & C. Pragma `EXTERNAL_NAME` is also provided.

>>> B108 supports `INTERFACE` for assembly & FORTRAN; `INTERFACE` is extended (beyond Ada!) to use an optional third parameter to designate that a procedure (Ada) is interfaced to a function (which might be necessary if the external function has parameters that are effectively "out" or "in out" in mode. Pragma `EXTERNAL_NAME` is also provided.

>>> B109 matches B108, with the difference that an additional form of `INTERFACE`, for "FORTRAN_FUNCTION", is provided (presumably to avoid the really illegal extension of using a third parameter--but that form is still available).

>>> B110 matches B107.

- >>> B111 supports INTERFACE for Assembler & COBOL. Pragma EXTERNAL_NAME is also provided.
- >>> B112 matches B075.
- >>> B114 supports INTERFACE for Ada, C, FORTRAN, & Pascal. Pragmas INTERFACE_NAME & EXTERNAL_NAME, and package MACHINE_CODE are provided.
- >>> B115 matches B114.
- >>> B118 supports INTERFACE to (?)--a general form? It is stated that the interfaced external subprogram must conform to the calling conventions of the compiler. Pragma LINKAGE_NAME is a complementary pragma. Pragma FOREIGN_BODY is a competing--and thus illegal (2.8:8)-- pragma.
- >>> B119 matches B118, with the addition of package MACHINE_CODE.
- >>> B120 matches B119; there is an indication that Tartan intends to have the <language-name> parameter identify the calling mechanism--either of "use-call" or "use-bal" [branch-and-link] (but that feature is not yet implemented).
- >>> B121 through B123 match B120.
- >>> B141 supports INTERFACE for assembler & "AIE_assembler"; pragma LINK_NAME is provided to interface with non-Ada identifiers.
- >>> B142 supports INTERFACE for "AIE_assembler" & "unspecified_language" (which presumably uses general calling & parameter-passing conventions); pragma LINK_NAME is also provided.
- >>> B143 matches B142.
- >>> B145 supports INTERFACE for assembly, Ada, C, & Intrinsic. Pragmas EXPORT, EXTERNAL_NAME, FOREIGN, & INTERFACE_NAME (INTERFACE_NAME's function duplicates an optional third parameter to INTERFACE).
- >>> B146 through B148 match B145.

**Appendix C -
C++ Compilers and Tools**

C++ Product: AT&T C++ Release 2.0 & 2.1

Vendor Data: AT&T Unix Software Operation
 1776 On the Green
 Morristown, N.J. 07960
 (800) 828-8649
 *Wayne Hunt
 *Paul Fillinich C++ Product Manager
 (908) 580-4363

Operating System:

DOS ☐
Microsoft Windows ☐
Unix ☐
VMS ☐
Other ☐

Hardware Platforms:

PC/Compatibles ☐
386/486. ☐
Mac. ☐
Workstations (Which) ☐

Product features:

cfront (AT&T) Yes
Class library ☐
Integrated development environment (IDE) ☐
Multiple inheritance ☐
Version control ☐

Translator. ☐
Compiler ☐
Cross compiler ☐
ANSI-C Compatible ☐
Assembler ☐
Debugger ☐
Profiler ☐

Product information:

Age of C++ marketed product:
Estimated number of licensed sites:
List price per copy

Notes:

Unable to get response to follow-up call.

C++ Product: Borland C++
Vendor Data: Borland International
 1800 Green Hills Road
 Scotts Valley, CA 95066
 (408) 438-5300

Operating System:

DOS Yes
 Microsoft Windows Yes
 Unix ☐
 VMS ☐
 Other ☐

Hardware Platforms:

PC/Compatibles Yes
 386/486. Yes
 Mac ☐
 Workstations (Which) ☐

Product features:

cfront (AT&T) No
 Class library Yes
 Integrated development environment (IDE) Yes
 Multiple inheritance Yes
 Version control No

 Translator. No
 Compiler Yes
 Cross compiler No
 ANSI-C Compatible Yes
 Assembler Yes
 Debugger Yes
 Profiler Yes

Product information:

Age of C++ marketed product. February 1991
 Estimated number of licensed sites: @350,000
 List price per copy \$495

Notes:

C++ Product: Turbo C++

Vendor Data: Borland International
1800 Green Hills Road
Scotts Valley, CA 95066
(408) 438-5300

Operating System:

DOS	Yes
Microsoft Windows	No
Unix	<input type="checkbox"/>
VMS	<input type="checkbox"/>
Other	<input type="checkbox"/>

Hardware Platforms:

PC/Compatibles	Yes
386/486	Yes
Mac	<input type="checkbox"/>
Workstations (Which)	<input type="checkbox"/>

Product features:

cfront (AT&T)	No
Class library	Yes
Integrated development environment (IDE)	Yes
Multiple inheritance	Yes
Version control	No
Translator	No
Compiler	Yes
Cross compiler	Yes
ANSI-C Compatible	Yes
Assembler	Yes
Debugger	Yes
Profiler	Yes

Product information:

Age of C++ marketed product:	May 90
Estimated number of licensed sites	
List price per copy	\$150

Notes:

C++ Product: C++ 2.0 & 2.1
Vendor Data: Comeau Computing
 91-34 120th St.
 Richmond Hill, NY 11418
 Marge Behrens
 (718) 849-2355

Operating System:

DOS Yes
 Microsoft Windows ☐
 Unix Yes
 VMS ☐
 Other Yes

Hardware Platforms:

PC/Compatibles Yes
 386/486. Yes
 Mac. ☐
 Workstations (Which) ☐
 RS 6000, 3B2 (Product on request)

Product features:

cfront (AT&T) Yes
 Class library Yes
 Integrated development environment (IDE) Yes
 Multiple inheritance Yes
 Version control No

 Translator. Yes
 Compiler ☐
 Cross compiler ☐
 ANSI-C Compatible Yes
 Assembler ☐
 Debugger ☐
 Profiler ☐

Product information:

Age of C++ marketed product: 1 year
 Estimated number of licensed sites: Unknown
 List price per copy \$250 - \$5500

Notes:

1. OS/2 Not at this time

C++ Product:

Vendor Data:

**Digital Equipment Corporation
111 Powdermill Road
Maynard, MA 01754
(508) 493-5111
Customer Assistance
Irwin Gerstenberger
(301) 306-6550**

Operating System:

DOS ☐
Microsoft Windows ☐
Unix ☐
VMS ☐
Other ☐

Hardware Platforms:

PC/Compatibles ☐
386/486. ☐
Mac. ☐
Workstations (Which) ☐

Product features:

cfront (AT&T) ☐
Class library ☐
Integrated development environment (IDE) ☐
Multiple inheritance ☐
Version control ☐

Translator. ☐
Compiler ☐
Cross compiler ☐
ANSI-C Compatible ☐
Assembler ☐
Debugger ☐
Profiler ☐

Product information:

Age of C++ marketed product:
Estimated number of licensed sites:
List price per copy

Notes:

1 - Does not have . Provide C++ from Unipress for DEC Station only.

C++ Product: G++ 1.39 (Did not know if native or preprocessor)

Vendor Data: Free Software Foundation
675 Massachusetts Ave
Cambridge, MA 02139
(617) 876-3296

Operating System:

DOS ☐
Microsoft Windows ☐
Unix Yes
VMS ☐
Other Yes

Note: 1

Hardware Platforms:

PC/Compatibles ☐
386/486 Yes
Mac ☐
Workstations (Which) Yes

Note: 2

Product features:

cfront (AT&T) No
Class library Yes
Integrated development environment (IDE) ☐
Multiple inheritance ☐
Version control Yes

Translator Yes, but own code
Compiler ☐
Cross compiler ☐
ANSI-C Compatible Yes
Assembler Yes
Debugger Yes
Profiler ☐

Product information:

Age of C++ marketed product: 3 years
Estimated number of licensed sites:
List price per copy \$200

Notes:

1 Apollo
2. Apollo, Alliant FX8, Altos 3068, AT&T 3B1, Convex 1 & 2, Dec 3100, DEC 5000,
DEC VAX, Encore Multimax, Gems 32000, harris SCX7 & 9, HP UX 68020, HP BSD, IBM PS2
under AIX, Intel 386 Xenix, IRIS Mips, ISI 68000 & 68020, Pyramid, Sequent Balance, Sequent
Symmetry, Sequent NS 3200, Sun 2, Sun 3, Sun 4, Sun Sparc and Sun 386i

C++ Product: Glockenspiel C++ (translator)
Vendor Data: Glockenspiel, Ltd.
 39 Lower Dominick St
 Dublin 1, Ireland
 marketed by: Imagesoft, Inc.
 2 Haven Avenue
 Port Washington, NY 11050
 Ramana Murthy(516) 767-2233

Operating System:

DOS Yes
 Microsoft Windows Yes
 Unix Yes
 VMS Yes
 Other OS2

Hardware Platforms:

PC/Compatibles Yes
 386/486 Yes
 Mac ☐
 Workstations (Which) ☐

Product features:

efront (AT&T) Yes
 Class library Yes
 Integrated development environment (IDE) Yes
 Multiple inheritance Yes
 Version control Yes

 Translator Yes
 Compiler ☐
 Cross compiler ☐
 ANSI-C Compatible ☐
 Assembler ☐
 Debugger Yes
 Profiler ☐

Product information:

Age of C++ marketed product: Since 85
 Estimated number of licensed sites: 20,000
 List price per copy \$499 - \$9000

Notes:

RS6000 Sun 3 & 4 & 386i, DECstation, DEC VAXStation, ICL DRS-3 & 6000, Sony News
 Fujitsu, CDC, MIPS RISC, DG Solbourne + many other platforms

C++ Product: HCR & SCO/C++
Vendor Data: HCR Corporation (bought SCO)
 130 Bloor Street West
 (416) 922-1937
 Brian Wadsworth 1-(408) 425-7222x5568
 Toronto, Ontario

Operating System:

DOS ☐
 Microsoft Windows ☐
 Unix Yes
 VMS ☐
 Other Open Desktop

Hardware Platforms:

PC/Compatibles ☐
 386/486. Yes
 Mac. ☐
 Workstations (Which) ☐

Product features:

cfront (AT&T) Yes
 Class library Yes
 Integrated development environment (IDE) Yes
 Multiple inheritance Yes
 Version control Yes

 Translator. Yes
 Compiler No
 Cross compiler ☐
 ANSI-C Compatible Yes
 Assembler No
 Debugger Yes
 Profiler No

Product information:

Age of C++ marketed product: 2 yes
 Estimated number of licensed sites: 450
 List price per copy \$1,195

Notes:

C++ Product: C++ Softbench SE Environment (is also subdivided into two separate products (C++ & Developer s Kit))

Vendor Data: Hewlett Packard
3000 Hanover St.
Palo Alto, CA 94304
(415) 857-1501
Dmitry Lenkov
(408)447-5279

Operating System:

DOS ☐
Microsoft Windows ☐
Unix Yes ☐
VMS ☐
Other ☐

Hardware Platforms:

PC/Compatibles ☐
386/486. ☐
Mac. ☐
Workstations (Which) Yes ☐

HP - 300, 700, 800..

Product features:

cfront (AT&T) ☐
Class library ☐
Integrated development environment (IDE) ☐
Multiple inheritance ☐
Version control ☐

Translator. ☐
Compiler ☐
Cross compiler ☐
ANSI-C Compatible ☐
Assembler ☐
Debugger ☐
Profiler ☐

Product information:

Age of C++ marketed product: October 1990
Estimated number of licensed sites: 2000
List price per copy \$2500

Notes:

C++ Product:**Vendor Data:**

HFSI
Honeywell
Honeywell Plaza
Minneapolis, MN 55408
(612) 870-5200
Elizabeth Fox (Unix)
(703) 827-3160
Laura O'Connor (Mainframe)
827-3382

Operating System:

DOS ☐
Microsoft Windows ☐
Unix Yes
VMS ☐
Other Yes

MAC OS,GCOS.

Hardware Platforms:

PC/Compatibles ☐
386/486. ☐
Mac. Yes
Workstations (Which) ☐
Bull

Product features:

cfront (AT&T) Yes (Unix)
Class library ☐
Integrated development environment (IDE) ☐
Multiple inheritance ☐
Version control ☐

Translator. Yes (Unix)
Compiler ☐
Cross compiler ☐
ANSI-C Compatible ☐
Assembler ☐
Debugger Yes
Profiler ☐

Product information:

Age of C++ marketed product: 1 year
Estimated number of licensed sites: 3-main frame
List price per copy \$1500 - \$19,800

Notes:

Could not reach correct people.

C++ Product: Intek C++ 2.0a
Vendor Data: Intek Integration Technologies
 1400 112th Ave., SE
 Bellevue, WA 98004
 Karen Harris
 Mac Cutchins
 (206) 455-9935

Operating System:

DOS Yes
 Microsoft Windows Yes
 Unix Yes
 VMS ☐
 Other

Hardware Platforms:

PC/Compatibles Yes
 386/486. Yes
 Mac.
 Workstations (Which) No

Product features:

cfront (AT&T) Yes
 Class library No
 Integrated development environment (IDE) No
 Multiple inheritance Yes
 Version control No

 Translator. Yes
 Compiler No
 Cross compiler ☐
 ANSI-C Compatible ☐
 Assembler ☐
 Debugger No
 Profiler ☐

Product information:

Age of C++ marketed product: 3 years
 Estimated number of licensed sites: 60 since Sep
 List price per copy \$495

Notes:

C++ Product: XCL Compiler 1.0 (They use Glockenspiel C++)

Vendor Data: International Business Machines
 Old Orchard Road
 Armonk, NY 10504
 (914) 765-1900
 Judy Griffen
 (301) 493-1273
 Rick Cimina (general point of contact) (301) 564-2329
 Ken Singer (301) 564-7662

Operating System:

DOS ☐

Microsoft Windows ☐

Unix Yes ☐

VMS ☐

Other ☐

Hardware Platforms:

PC/Compatibles ☐

386/486. ☐

Mac. ☐

Workstations (Which) Yes

IBM RS6000.

Product features:

cfront (AT&T) ☐

Class library ☐

Integrated development environment (IDE) ☐

Multiple inheritance ☐

Version control ☐

Translator. ☐

Compiler ☐

Cross compiler ☐

ANSI-C Compatible ☐

Assembler ☐

Debugger Yes ☐

Profiler ☐

Product information:

Age of C++ marketed product: 1 - yr

Estimated number of licensed sites: 30,000

List price per copy Provided with O.S.

Notes:

C++ Product:

Vendor Data:

**Microsoft Corp.
One Microsoft Way
Redmond, WA 98073
(206) 882-8080
(800) 426-9400**

Operating System:

DOS ☐
Microsoft Windows ☐
Unix ☐
VMS ☐
Other ☐

Hardware Platforms:

PC/Compatibles ☐
386/486. ☐
Mac. ☐
Workstations (Which) ☐

Product features:

cfront (AT&T) ☐
Class library ☐
Integrated development environment (IDE) ☐
Multiple inheritance ☐
Version control ☐

Translator. ☐
Compiler ☐
Cross compiler ☐
ANSI-C Compatible ☐
Assembler ☐
Debugger ☐
Profiler ☐

Product information:

Age of C++ marketed product:
Estimated number of licensed sites:
List price per copy

Notes:

Do not have one.

C++ Product:

Vendor Data:

NCR
1700 S. Patterson Blvd.
Dayton, OH
(513) 445-5000
(301) 258-6500
Blaise Fanucchi
(301) 921-6402

Operating System:

DOS ☐
Microsoft Windows ☐
Unix ☐
VMS ☐
Other ☐

Hardware Platforms:

PC/Compatibles ☐
386/486 ☐
Mac ☐
Workstations (Which) ☐

Product features:

cfront (AT&T) ☐
Class library ☐
Integrated development environment (IDE) ☐
Multiple inheritance ☐
Version control ☐

Translator ☐
Compiler ☐
Cross compiler ☐
ANSI-C Compatible ☒
Assembler ☐
Debugger ☐
Profiler ☐

Product information:

Age of C++ marketed product:
Estimated number of licensed sites:
List price per copy

Notes:

Resell Glockenspiel 2.0, and AT&T 2.0
Both products are tied to cooperative agreements and will not be available until July and November respectively.

C++ Product: Green Hills C++
Vendor Data: Oasys
 One Cranberry Hill
 Lexington, MA 02173
 Norm Donchin
 Kevin Gallagher
 (617) 862-2002

Operating System:

DOS ☐
 Microsoft Windows ☐
 Unix Yes
 VMS Yes
 Other ☐

Hardware Platforms:

PC/Compatibles ☐
 386/486. Yes
 Mac. ☐
 Workstations (Which) Yes

Note: 1 & 2.

Product features:

cfront (AT&T) Also
 Class library Yes (AT&T)
 Integrated development environment (IDE) No
 Multiple inheritance Yes
 Version control No

 Translator. Also
 Compiler Yes
 Cross compiler Yes
 ANSI-C Compatible Yes
 Assembler Yes
 Debugger No
 Profiler No

Product information:

Age of C++ marketed product: 18 mo
 Estimated number of licensed sites: 2000
 List price per copy \$1,000 to 5,250Cross \$2,200 to 20,000

Notes:

- 1 Micro Vax, Sun, IBM, MIPS
- 2680x0, 88000, 386, i860
3. Have compiler and translator

C++ Product: Oregon C++
Data: Oregon Software, Inc.
 7352 SW Durham Road
 Portland, OR 97224
 Michael Stearns
 (503) 624-6883

Operating System:
 DOS ☐
 Microsoft Windows ☐
 Unix Yes
 VMS Yes
 Other HP,Sun OS,NCR, News

Hardware Platforms:
 PC/Compatibles ☐
 386/486. Yes
 Mac. ☐
 Workstations (Which) Yes

See Notes.....

Product features:
 cfront (AT&T) No
 Class library No
 Integrated development environment (IDE) No
 Multiple inheritance Yes
 Version control Separate

 Translator. ☐
 Compiler Yes
 Cross compiler Yes
 ANSI-C Compatible Yes
 Assembler Yes
 Debugger Yes
 Profiler No

Product information:
 Age of C++ marketed product: June 1988
 Estimated number of licensed sites: 2000
 List price per copy 386 - \$995, Unix - \$1700,
 o MicroVAX, Micro VAX II, 2xx,31xx,32xx,33xx,34xx,35xx,36xx,38xx,39xx
 o VAX 730,750,780,8250,8350, 8800, 8810, 85xx,86xx,87xx,
 o VAX 6210,6220.,6230,6240,6310,6320,6340, 6350, 6360,6410, 6420, 6430, 6440, 6450, 6460
 o VAX 656510, 6520, 6530, 6540, 6550, 6560
 o VAX 4000
 o VAX 9000
 o VAXstation 2xxx,3xxx,8xxx, II, DECstation 21xx,31xx51xx
 o VAXserver 3xxx,Dec 5000/200, DECsys 54xx,5500, 5810, 5820, 5830, 5840
 o 80386 Unix
 o Stratus 30, XA 200

- o Sony News 3710
- o Sun 3,4/20, SPARC1 & II, IPC 4/40, 4/60, 4/1xx, 4/60, 4/65,4/330.4/360,4/370,4/470,4/490
- o Solbourne 4xx,5xx,6xx,8xx
- o IBM RS/600 320,520,530,540,550, 730, 930
- o EG Aviiion 2xx,3xx,3xxx,4xx,4xxx,5xxx,6xxx
- o MIPS RS1210, RISC Magnum 3000, RC3230,RS2030, RC3240, M/2000,RC6280

C++ Product: Peritus C++//Ansi C
Vendor Data: Peritus International (purchased by Lucid)
 10201 Torre Ave, Suite 295
 Cupertino, CA 95014
 Rick Bedigo
 (415) 329-8400

*Compiler is not yet released (anticipate @3rd quarter)

Operating System:

DOS ☐
 Microsoft Windows ☐
 Unix Yes
 VMS ☐
 Other ☐

Hardware Platforms:

PC/Compatibles ☐
 386, 486 Yes
 Mac ☐
 Workstations (Which) Yes

Sun / Sun Sparc.

Product features:

cfront (AT&T) ☐
 Class library ☐
 Integrated development environment (IDE) ☐
 Multiple inheritance ☐
 Version control ☐

 Translator ☐
 Compiler ☐
 Cross compiler ☐
 ANSI-C Compatible ☐
 Assembler ☐
 Debugger ☐
 Profiler ☐

Product information:

Age of C++ marketed product: 2 Yrs
 Estimated number of licensed sites: 25
 List price per copy 1000

Notes:

Some old copies of Peritus are out there, but we will not release C++ compiler until the third quarter of this year.

C++ Product:

Vendor Data:

**Saber Software
185 Alewife Brook Parkway
Cambridge, MA 02138
(617) 876-7636**

Operating System:

DOS ☐
Microsoft Windows ☐
Unix Yes
VMS ☐
Other ☐

Hardware Platforms:

PC/Compatibles ☐
386/486. ☐
Mac. ☐
Workstations (Which) Sun

Product features:

cfront (AT&T) Yes
Class library No
Integrated development environment (IDE) Yes
Multiple inheritance ☐
Version control ☐

Translator. Yes
Compiler ☐
Cross compiler ☐
ANSI-C Compatible ☐
Assembler ☐
Debugger. Yes
Profiler ☐

Product information:

Age of C++ marketed product: December 1990
Estimated number of licensed sites: 1000
List price per copy \$2696 - \$3696

Notes:

C++ Product:

Vendor Data:

**Silicon Graphics
(415) 960-1980
Michelle Chambers
Dave Bagshaw**

Operating System:

DOS ☐
Microsoft Windows ☐
Unix Yes
VMS ☐
Other ☐

Hardware Platforms:

PC/Compatibles ☐
386/486. ☐
Mac. ☐
Workstations (Which) Yes

Iris.

Product features:

cfront (AT&T) Yes
Class library Unknown
Integrated development environment (IDE) ☐
Multiple inheritance Unknown
Version control ☐

Translator. ?
Compiler Yes
Cross compiler No
ANSI-C Compatible ☐
Assembler Unknown
Debugger Yes
Profiler Unknown

Product information:

Age of C++ marketed product: 6 months
Estimated number of licensed sites: Not a lot
List price per copy \$1195

Notes:

C++ Product: Sun C++ Version 2.1
Vendor Data: Sun Microsystems, Inc
5500 Garcia Ave.
Mountain View, CA
(415) 960-1300
Aaron Masciocra
(800) 872-4786

Operating System:

DOS ☐
Microsoft Windows ☐
Unix Yes
VMS ☐
Other ☐

Hardware Platforms:

PC/Compatibles ☐
386/486. ☐
Mac. ☐
Workstations (Which) Sun 3, Sun 4, Sparc

Product features:

cfront (AT&T) Yes
Class library Yes
Integrated development environment (IDE) Yes
Multiple inheritance No
Version control ☐

Translator. Yes
Compiler ☐
Cross compiler ☐
ANSI-C Compatible ☐
Assembler ☐
Debugger Yes
Profiler ☐

Product information:

Age of C++ marketed product: Apr 12, 91
Estimated number of licensed sites: unknown
List price per copy \$2,000

Notes:

C++ Product:

Vendor Data:

**Taumatic
1094 Cudahy Pl.
Suite 302
San Diego, CA 92110
Steve Clamadge
(619) 697-7607**

Developed for Oregon does not sell to end users

Operating System:

DOS ☐
Microsoft Windows ☐
Unix Yes
VMS Yes
Other ☐

Hardware Platforms:

PC/Compatibles ☐
386/486 Yes
Mac ☐
Workstations (Which) Yes

Sun 3, HP9000, Sun 4.

Product features:

cfront (AT&T) No
Class library No
Integrated development environment (IDE) ☐
Multiple inheritance ☐
Version control ☐

Translator. No
Compiler Yes
Cross compiler No
ANSI-C Compatible Yes
Assembler No
Debugger No
Profiler ☐

Product information:

Age of C++ marketed product: Feb1988
Estimated number of licensed sites: 3 Vendors
List price per copyTranslator C(soor:) \$35,000 Compiler front end \$50,000

Notes:

Has sold to three companies, Oregon and could not release names of other two.

C++ Product: Zortech C++ Developers Edition

Vendor Data: Zortech
4-c Gill St.
Woburn, MA 01801
Renee Pace
(617) 937-0696

Operating System:

DOS	Yes
Microsoft Windows	Yes
Unix	Yes
VMS	<input type="checkbox"/>
Other	Yes

MAC OS, OS/2.

Hardware Platforms:

PC/Compatibles	Yes
386/486	Yes
Mac	Yes
Workstations (Which)	<input type="checkbox"/>

Product features:

cfront (AT&T)	No
Class library	Yes
Integrated development environment (IDE)	Yes
Multiple inheritance	Yes
Version control	No
Translator	<input type="checkbox"/>
Compiler	Yes
Cross compiler	No
ANSI-C Compatible	Yes
Assembler	No in line
Debugger	Yes
Profiler	No

Product information:

Age of C++ marketed product:	May 88
Estimated number of licensed sites:	200,000
List price per copy	\$200 - \$1000

Notes:

**Appendix D -
C++ Standardization Sponsors**

Accredited Standards Committee Doc No: X3J16/91-0001R2
X3, INFORMATION PROCESSING SYSTEMS* Date: May 13, 1991
Project: 738-D (PL C++)
*Operating under the procedures of the Ref Doc:
American National Standards Institute Reply to: William M. Miller
Standards Secretariat, Computer and wmm@world.std.com
Business Equipment Manufacturers Association BIX: wmiller
(CBEMA), 311 First St. NW, Ste. 500, CompuServe: 72105,1744
Washington, DC 20001-2178

ANSI X3J16 membership list
(Liaisons and representatives with no voting rights:)

Affiliation : SPARC Liaison to X3J16

Membership : Ex Officio
Name : Scott Jameson
Address : Sun Microsystems Federal
2550 Garcia Ave., M6-94
Mountain View, CA 94043
Tel : (408) 276-3642
Fax : (408) 945-9483
Email : skj@ebay.sun.com

Affiliation : X3 Secretariat

Membership : Ex Officio
Name : Kathleen M. McMillan
Address : X3 Secretariat, CBEMA
311 First Street NW, Suite 500
Washington DC 20001
Tel : (202) 626-5742
Fax :
Email :

Affiliation : X3J9 (Pascal)

Membership : Liaison

Name : Thomas N. Turba
Address : Unisys Corp.
MS 4672
P. O. Box 64942
St. Paul, MN 55164-0942
Tel : (612) 635-6774
Fax : (612) 635-3899
Email : turba@rsvl.Unisys.com

Members who have voting rights for the June, 1991 meeting

Affiliation : Amdahl, Inc.

Membership : Principal

Name : Wolfgang Pieb
Address : 1250 E. Arques Ave. (M/S 580)
P. O. Box 3470
Sunnyvale, CA 94088-3470
Tel : (415) 623-2105
Fax :
Email : wolfy@vienna.key.com

Membership : Alternate

Name : Neal Weidenhofer
Address : same as above
Tel : (408) 737-5007
Fax :
Email : nw@amdahl.com

Membership : Observer

Name : Judy Smith
Address : UTS Languages
Amdahl Corporation
1250 East Arques Ave., M/S 316
Sunnyvale, CA 94088
Tel :
Fax :

Email : jas@uts.amdahl.com

Affiliation : Apple Computer Inc.

Membership : Principal

Name : Bill Gibbons

Address : Apple Computer Inc.

20525 Mariani Avenue, MS 37-CL

Cupertino, CA 95014

Tel : (408) 974-7803

Fax : (408) 974-1763

Email : bgibbons@apple.com

Membership : Alternate

Name : Richard Meyers

Address : same as above

Tel : (408) 974-3285

Fax : (408) 974-1763

Email : meyers@apple.com

Membership : Alternate (Second)

Name : Elizabeth Crockett

Address : same as above

Tel : (408) 974-5084

Fax : (408) 974-1763

Email : eec1@apple.com

Membership : Alternate (Third)

Name : Norris Boyd

Address : same as above

Tel : (408) 974-4391

Fax : (408) 974-1763

Email : norris@apple.com

Affiliation : AT&T

Membership : Principal

Name : Jonathan E. Shopiro

Address : AT&T
184 Liberty Corner Rd., Rm.4N-C05
Warren, NJ 07059-0908
Tel : (908) 580-4229
Fax : (908) 580-5631
Email : shopiro@research.att.com

Membership : Alternate
Name : Margaret Quinn
Address : AT&T
190 River Rd.
Summit, NJ 07901
Tel : (201) 522-5088
Fax : (201) 522-6621
Email : meq@attunix.att.com

Membership : Observer
Name : Bjarne Stroustrup
Address : AT&T Bell Labs
Murray Hill, NJ 07974
Tel : (201) 582-7393
Fax :
Email : bs@research.att.com

Membership : Alternate (Second)
Name : Andrew Koenig
Address : AT&T Bell Labs
184 Liberty Corner Rd., #4N-R12
Warren, NJ 07059-0908
Tel : (908) 580-4883
Fax : (908) 580-4127
Email : ark@europa.att.com

Membership : Observer
Name : Tony Hansen
Address : AT&T Bell Labs, Rm 3B-315
307 Middletown-Lincroft Rd.
Lincroft, NJ 07738

Tel : (908) 576-3207
Fax : (908) 576-3321
Email : hansen@pegasus.att.com or attmail!tony

Affiliation : Bellcore (Bell Communications Research)

Membership : Principal
Name : Steve Carter
Address : Bellcore
444 Hoes Lane, RRC 4A737
Piscataway, NJ 08854
Tel : (908) 699-6732
Fax : (908) 463-1965
Email : slc2@bcr.cc.bellcore.com or bellcore!bcr!slc2

Membership : Alternate
Name : Eric Krohn
Address : same as above
Tel : (908) 699-2708
Fax :
Email : krohn@bae.bellcore.com

Membership : Alternate (Second)
Name : Wen-Yau Hsieh
Address : same as above
Tel : (908) 699-8275
Fax :
Email : hwy@bellcore.com

Affiliation : Borland International

Membership : Principal
Name : Peter Becker
Address : Borland International
1800 Green Hills Road
Scotts Valley, CA 95066-0001
Tel : (408) 439-1678
Fax :

Email : 0003468454@mcimail.com

Membership : Alternate

Name : Peter Kukol

Address : same as above

Tel :

Fax :

Email :

Affiliation : The C-Team, Inc.

Membership : Principal

Name : Randall Swan

Address : The C-Team, Inc.

60 East 12th Street

New York, NY 10003

Tel : (212) 477-3990

Fax : (212) 982-7460

Email : swan@norton.acf.nyu.edu

Affiliation : Chicago Research and Trading

Membership : Principal

Name : John W. Bruns

Address : CRT Group Ltd., 34th floor

440 S. LaSalle St.

Chicago, IL 60605

Tel : (312) 431-2506

Fax : (312) 431-3089

Email : jwb@cup.portal.com

Membership : Alternate

Name : Alan Losoff

Address : same as above

Tel : (312) 431-2521

Fax : (312) 431-3089

Email :

Affiliation : Comeau Computing *

Membership : Principal

Name : Greg Comeau

Address : Comeau Computing

91-34 120th Street

Richmond Hill, NY, 11418

Tel : (718) 945-0009

Fax :

Email : attmail!csanta!greg

Affiliation : Control Data Corporation

Membership : Principal

Name : Paul H. Kohlmler

Address : Control Data Corporation

5101 Patrick Henry Drive

Santa Clara, CA 95054

Tel : (408) 496-4276

Fax :

Email : paul@svl.cdc.com

Affiliation : Cygnus Support

Membership : Principal

Name : Michael Tiemann

Address : Cygnus Support

814 University Avenue

Palo Alto, CA 94301

Tel : (415) 322-3811

Fax :

Email : tiemann@cygnus.com

Affiliation : Data General

Membership : Alternate

***. May lost voting rights if not present at this meeting**

Name : Joel Schnoor
Address : Data General
62 T.W. Alexander Dr.
Research Triangle Park, NC 27709
Tel :
Fax :
Email : schnoor@dg-rtp.dg.com

Affiliation : DEC (Digital Equipment Corporation)

Membership : Principal
Name : Aron Insinga
Address : Digital Equipment Corporation
110 Spit Brook Rd.
Nashua, NH 03062
Tel : (603) 881-1928
Fax : (603) 881-0120
Email : insinga@tle.enet.dec.com or decwrl!tle.enet.dec.com!insinga

Membership : Observer
Name : Michael Young
Address : same as above
Tel : (603) 881-2888
Fax :
Email : young@asd.enet.dec.com

Affiliation : DECUS

Membership : Principal
Name : Charles Allison
Address : LDS Church Information Systems
50 E. North Temple Street
Salt Lake City, UT 84150
Tel : (801) 240-4510
Fax :
Email : allison@dcs.dec.org or terrazas@eisner.dec.org

Affiliation : Glockenspiel, Ltd.

Membership : Principal
Name : William M. Miller
Address : Glockenspiel, Ltd.
P. O. Box 366
Sudbury, MA 01776-0003
Tel : (508) 443-5779
Fax : (508) 443-5779
Email : wmm@world.std.com

Membership : Alternate
Name : Stephen C. Dewhurst
Address : 12 Oakmere Drive
Fort Salonga, NY 11768
Tel : (516) 757-1916
Fax : (516) 757-5729
Email : 73730.2127@CompuServe.COM

Affiliation : Hewlett-Packard

Membership : Principal
Name : Dmitry Lenkov
Address : HP California Language Lab
19447 Pruneridge Avenue, MS: 47LE
Cupertino, CA 95014
Tel : (408) 447-5279
Fax : (408) 447-4924
Email : dmitry@hpclndl.hp.com or dmitry%hpda@hplabs.hp.com

Membership : Alternate
Name : John Vasta
Address : HP Apollo Division
300 Apollo Dr, M.S. CHD-03-LT
Chelmsford, MA 01824
Tel : (508) 256-6600 x5978
Fax :
Email : vasta@APOLLO.HP.COM

Membership : Observer

Name : Richard Holman
Address : HP California Language Lab
19447 Pruneridge Avenue, MS: 47LE
Cupertino, CA 95014
Tel : (408) 447-7312
Fax : (408) 447-4924
Email : rholman@hpcclld.cup.hp.com

Membership : Observer
Name : Tim O'Konski
Address : HP, SESD-Bld.101A
1266 Kifer Road
Sunnyvale, CA 94086
Tel : (408) 746-5542
Fax : (408) 746-5539
Email : tim@hp-ses.sde.hp.com or tim%hp-ses@hplabs.hp.com or

Membership : Observer
Name : Robert Seliger
Address : HP Clinical Information Systems
175 Wyman Street
Waltham, MA 02254
Tel : (617) 890-6300
Fax :
Email : robs@hpwall.hp.com

Affiliation : IBM

Membership : Principal
Name : Kim Knuttila
Address : IBM
844 Don Mills Rd.
North York, Ontario
Canada M3C 1V7
Tel : (416) 448-2171
Fax :
Email : knuttila@torolab6.iinus1.ibm.com

Membership : Alternate
Name : Shawn Elliott
Address : same as above
Tel : (416) 448-2172
Fax :
Email : ELLIOTT@IBM.COM

Membership : Alternate (Second)
Name : Jos\202e Lajoie
Address : same as above
Fax :
Email : lajoie@torolab6.iinus1.ibm.com

Membership : Alternate (Third)
Name : Christopher F. Codella
Address : IBM T. J. Watson Research Ctr
P. O. Box 704
Yorktown Heights, NY 10598
Tel : (914) 784-7511
Fax : (914) 784-7455
Email : codella@ibm.com

Affiliation : KnowledgeWare

Membership : Principal
Name : Gotham Polisetty
Address : KnowledgeWare
3340 Peachtree Road, N.E.
Atlanta, GA 30326
Tel : (404) 231-8575
Fax : (404) 364-0883
Email : ...!{emory|gatech}!dscatl!kwiatl!gotham

Affiliation : Kubota Pacific Computer, Inc.

Membership : Principal
Name : David Wallace
Address : Kubota Pacific Computer, Inc.

2630 Walsh Ave.
Santa Clara, CA 95051-0905
Tel : (408) 748-6335
Fax : (408) 748-6335
Email : davidw@kpc.com

Affiliation : Language Processors, Inc. (LPI)

Membership : Principal
Name : David G. Michaels
Address : Language Processors, Inc.
959 Concord Street
Framingham, MA 01701-4613
Tel : (508) 626-0006
Fax : (508) 626-2221
Email : david@lpi.liant.com or necntc.nec.com!lpi!david or
hpcea!hplabs!rutgers!necntc.nec.com!lpi!david or david@lpi.UUCP

Membership : Alternate
Name : Prescott K. Turner, Jr.
Address : same as above
Tel : (508) 626-0006
Fax : (508) 626-2221
Email : pkt@lpi.liant.com

Affiliation : Lucid, Inc. *

Membership : Principal
Name : Sassan Hazeghi
Address : Lucid, Inc.
707 Laurel St.
Menlo Park, CA 94025
Tel : (415) 329-8400 x5519
Fax : (415) 329-8480
Email : sassan@lucid.com

Membership : Alternate
Name : Fariborz Jahanian
Address : same as above

Tel : (415) 329-8400
Fax : (415) 329-8480
Email : fariborz@lucid.com

Membership : Alternate (second)

Name : Jerry Schwarz
Address : same as above
Tel : (415) 329-8400
Fax : (415) 329-8480
Email : jss@lucid.com

Affiliation : Lund Inst. of Technology, Dept. of Automatic Control

Membership : Principal

Name : Dag Michael Brå201ck
Address : Box 118
S-221 00 LUND
Sweden
Tel : +46 - 46 10 87 79
Fax : +46 - 46 13 81 18
Email : dag@Control.LTH.Se

Affiliation : Mentor Graphics Corporation

Membership : Principal

Name : Laura Yaker
Address : Mentor Graphics Corporation
8005 S.W. Boeckman Road
Wilsonville, OR 97070-7777
Tel : (503) 685-7000
Fax :
Email : laura_yaker@mentorg.com

Membership : Alternate

Name : Jim Howard
Address : same as above
Tel : (503) 685-7000
Fax :

Email : jim_howard@mentorg.com

Affiliation : Metaware

Membership : Principal

Name : Tom Pennello

Address : Metaware

2161 Delaware Avenue

Santa Cruz, CA 95060-5706

Tel : (408) 429-6382

Fax : (408) 429-9273

Email : uunet!metaware!tom

Affiliation : Microsoft Corporation

Membership : Principal

Name : Martin O'Riordan

Address : Microsoft Corporation

1 Microsoft Way

Redmond, WA 98052

Tel : (206) 882-8080

Fax : (206) 883-8101

Email : uunet!microsoft!martino

Membership : Alternate

Name : David F. Weil

Address : same as above

Tel : (206) 882-8080

Fax : (206) 883-8101

Email : uunet!microsoft!davewe

Membership : Alternate

Name : David T. Jones

Address : same as above

Tel : (206) 882-8080

Fax : (206) 883-8101

Email : uunet!microsoft!davidj

Membership : Alternate

Name : Mitchell T. Harter
Address : same as above
Tel : (206) 882-8080
Fax : (206) 883-8101
Email : uunet!microsoft!mitchh

Membership : Alternate
Name : Mark L. Langley
Address : same as above
Tel : (206) 882-8080
Fax : (206) 883-8101
Email : uunet!microsoft!marklan

Membership : Observer
Name : Keith Rowe
Address : same as above
Tel :
Fax :
Email :

Membership : Alternate
Name : Jan Gray
Address : same as above
Tel :
Fax :
Email :

Membership : ?
Name : James L. Adcock
Address : same as above
Tel :
Fax :
Email :

Affiliation : Microtec Research Inc. *

Membership : Principal
Name : Lily Chang

Address : Microtec Research, Inc.
2350 Mission College Blvd.
Regency Plaza #1
Santa Clara, CA 95054
Tel : (408) 980-1300 x503; 408-980-8484 x503; (800) 950-5554
Fax : (408) 982-8266
Email : amdcad!sun0!lily

Membership : Alternate
Name : Praveen Moudgal
Address : same as above
Tel : (408) 980-1300 or (800) 950-5554
Fax : (408) 982-8266
Email : amdcad!sun0!praveen

Membership : Observer
Name : Atul Behari
Address : same as above
Tel : (408) 980-1300 or (800) 950-5554
Fax : (408) 982-8266
Email : amdcad!sun0!atul

Affiliation : National Institute of Standards and Technology

Membership : Principal
Name : Michael McLay
Address : Nat'l Inst. of Stds and Technology
Bld 220, Rm A150
Gaithersburg, MD 20899
Tel : (301) 975-4099
Fax :
Email : mclay@cme.nist.gov

Affiliation : NCR Corporation

Membership : Principal
Name : Rick Schubert
Address : NCR Corporation
AEP Department

16550 W. Bernardo Drive

San Diego, CA 92127

Tel : (619) 485-2245

Fax :

Email : rick.shubert@sandiego.NCR.COM or rns@tortuga.SanDiego.NCR.COM

Membership : Alternate

Name : Patrick Mansfield

Address : NCR Systems Engineering

9900 Old Grove Rd.

San Diego, CA 92131

Tel : (619) 693-5735

Fax :

Email : pat@se-sd.SanDiego.NCR.COM

Affiliation : ObjectWare, Inc.

Membership : Principal

Name : Michael J. Vilot

Address : ObjectWare, Inc.

16 Warton Road

Nashua, NH 03062-2537

Tel : (603)888-4729

Fax :

Email : mjv@objects.mv.com

Affiliation : Open Software Foundation (OSF)

Membership : Principal

Name : E. Andrew Johnson

Address : Open Software Foundation

11 Cambridge Center

Cambridge, MA 02142

Tel : (617) 621-8794

Fax : (617) 225-2782

Email : andyj@osf.org

Affiliation : Oregon Software, Inc. *

Membership : Principal
Name : Linda Cline
Address : Oregon Software, Inc.
7352 S.W. Durham Road
Portland, OR 97224
Tel : (503) 624-6883
Fax : (503) 620-6093
Email : linda@oresoft.com

Affiliation : Perennial, Inc.

Membership : Principal
Name : Paul Stone
Address : Perennial, Inc.
4699 Old Ironsides Dr, Ste. 210
Santa Clara, CA 95054
Tel : (408) 748-2900
Fax :
Email : uunet!peren!paul

Membership : Alternate
Name : Barry Hedquist
Address : same as above
Tel :
Fax :
Email :

Affiliation : Pine Creek Software

Membership : Principal
Name : Dr. Samuel P. Harbison
Address : Pine Creek Software
305 S. Craig Street, Suite 300
Pittsburgh, PA 15213
Tel : (412) 681-9811
Fax :
Email : harbison@tartan.com

Affiliation : Plum Hall Inc.

Membership : Principal

Name : Thomas Plum

Address : Plum Hall, Inc.

1 Spruce Ave.

Cardiff, NJ 08232

Tel : (609) 927-3770

Fax : (609) 653-1903

Email : plum@plumhall.com

Affiliation : Prime Computer, Inc.

Membership : Principal

Name : Tom Bucken

Address : Prime Computer, Inc., MS 10-21

500 Old Connecticut Path

Framingham, MA 01701

Tel : (508) 620-2800 x4873

Fax :

Email : bucken@s35.prime.com

Membership : Alternate

Name : Sheryl Horowitz

Address : same as above

Tel : (508) 879-2960 x4084

Fax :

Email :

Affiliation : Program Conversions Inc.

Membership : Principal

Name : Reg Charney

Address : Program Conversions Inc.

70 Myrtle Blvd

Larchmont, NY 10538-2344

Tel : (914) 833-0762

Fax : (914) 833-2404

Email :

Affiliation : Pyramid Technology Corp. *

Membership : Principal

Name : Raman Govindarajan

Address : Pyramid Technology Corp.

1295 Charleston Road

Mountain View, CA 94043

Tel : (415) 335-8751

Fax : (415) 968-8084

Email : rgovind@pyrmis.pyramid.com

Affiliation : Rank Xerox France / Universite de Paris VI

Membership : Principal

Name : Philippe Gautron

Address : Universite de Paris VI - LITP,

4 place Jussieu

75252 PARIS CEDEX 05

FRANCE

Tel : litp: +33 (1) 44 27 61 99, rxf: +33 (1) 47-62-11-39

Fax : litp: +33 (1) 44 27 40 42, rxf: +33 (1) 47-62-10-88

Email : gautron@rxf.ibp.fr

Affiliation : Rational Systems, Inc. *

Membership : Principal

Name : Terry Colligan

Address : Rational Systems, Inc.

220 N. Main Street

Natick, MA 01760

Tel : (508) 653-6006

Fax : (508) 653-2753

Email :

Affiliation : Revolution 2

Membership : Principal

Name : Bruce Eckel
Address : Revolution2
P.O. Box 760
Kennett Square, PA 19348
Tel : (302) 456-5878
Fax : (302) 456-5879
Email :

Affiliation : Roskind Software

Membership : Principal
Name : James Roskind
Address : 516 Latania Palm Dr.
Indialantic, Florida 32903
Tel : (407) 729-4348
Fax :
Email : jar@hq.ileaf.com

Affiliation : Saks & Associates

Membership : Principal
Name : Daniel Saks
Address : Saks & Associates
287 W. McCreight Avenue
Springfield, Ohio 45504
Tel : (513) 324-3601
Fax :
Email : dsaks@wittenberg.edu

Membership : Alternate
Name : Nancy Saks
Address : same as above
Tel : (513) 324-3601
Fax :
Email : nksaks@wittenberg.edu

Affiliation : SAS Institute, Inc.

Membership : Principal

Name : Gavin Koch
Address : SAS Institute, Inc.
SAS Circle
Box 8000
Cary, North Carolina 27512
Tel : (919) 677-8000 ext. 6988
Fax :
Email : sasgak@dev.sas.com

Membership : Alternate
Name : Gary Merrill
Address : same as above
Tel : (919) 677-8000 ext. 6873
Fax :
Email :

Affiliation : SCO Canada, Inc.

Membership : Principal
Name : Ron Irvine
Address : SCO Canada, Inc.
130 Bloor St. W., 10th Floor
Toronto, Ontario M5S 1N5
Canada
Tel : (416) 922-1937
Fax : (416) 922-8397
Email : ron@sco.com or uunet!sco!ron

Membership : Alternate
Name : Paul Jackson
Address : same as above
Tel : (416) 922-1937
Fax : (416) 922-8397
Email : paul@sco.com or uunet!sco!paul

Affiliation : Silicon Graphics Computer Systems

Membership : Principal
Name : John Wilkinson

Address : Silicon Graphics Computer Systems
2011 N. Shoreline Boulevard, MS 9U-530
Mountain View, CA 94039-7311
Tel : (415) 335-1816
Fax : (415) 969-2314
Email : jfw@wpd.sgi.com

Affiliation : Sun Microsystems, Inc.

Membership : Principal
Name : Doug Landauer
Address : Sun Microsystems, Inc.
2550 Garcia Ave., M/S 12-40
Mountain View, CA 94043
Tel : (415) 336-6277
Fax : (415) 964-0946
Email : landauer@sun.com

Membership : Alternate
Name : Ted Goldstein
Address : same as above
Tel : (415) 336-3087
Fax :
Email : tedg@sun.com

Affiliation : TauMetric Corporation

Membership : Principal
Name : Michael S. Ball
Address : TauMetric Corporation
8765 Fletcher Pkwy, Ste. 301
La Mesa, CA 91942
Tel : (619) 697-7607
Fax : (619) 697-1140
Email : mike@taumet.com

Membership : Alternate
Name : Stephen D. Clamage

Address : same as above
Tel : (619) 697-7607
Fax : (619) 697-1140
Email : steve@taumet.com

Affiliation : Tektronix, Inc.

Membership : Principal
Name : Cynthia Ellis
Address : Tektronix, Inc.
P. O. Box 500, M/S 50-662
Beaverton, OR 97077
Tel : (503) 627-6680
Fax : (503) 627-5502
Email : ellis@crl.labs.tek.com

Affiliation : Texas Instruments

Membership : Principal
Name : Mary J. Fontana
Address : Texas Instruments
P.O. Box 655474, M/S 238
Dallas, Texas 75265
Tel : (214) 995-0787
Fax : (214) 995-0304
Email : fontana@csc.ti.com

Membership : Alternate
Name : Brian M. Kennedy
Address : same as above
Tel : (214) 995-4117
Fax : (214) 995-0304
Email : bmk@csc.ti.com

Membership : 2nd alternate
Name : Thomas J. Traughber
Address : Texas Instruments
6550 Chase Oaks Blvd, M/S 8467
Plano, TX 75023

Tel : (214) 575-3588
Fax : (214) 575-4826
Email : Tom_Traugher@mcimail.com or 4622844@mcimail.com

Membership : 3rd alternate
Name : Shawn Islam
Address : Texas Instruments
P. O. Box 149149, M/S 2078
Austin, TX 78714-9149
Tel : (512) 250-6261
Fax : (512) 250-7104
Email : shawn.islam@hub.dsg.ti.com

Affiliation : Unisys Corp.

Membership : Principal
Name : Steve Cherry
Address : Unisys, MS: A29D
2476 Swedesford Rd.
P.O. Box 203
Paoli, PA 19301
Tel : (215) 648-4482
Fax : (215) 648-4624
Email : cherry@nodec.RSVL.UNISYS.COM

Membership : Alternate
Name : Don Bixler
Address : Unisys Corp., MS 4872
P.O. Box 64942
St. Paul, MN 55164-0942
Tel : (612) 635-7616
Fax : (612) 635-3899
Email : 2bixler@rsvl.unisys.com

Affiliation : US WEST

Membership : Principal
Name : Susan Waggoner

Address : US WEST, ITS, Room 950
2 Central Park Plaza
100 S. 19th St.
Omaha, NE 68102
Tel : (402) 422-5590
Fax : (402) 422-5537
Email : uunet!bttn!null!susan

Membership : Alternate
Name : Paul Zeiger
Address : US WEST Advanced Technologies
6200 South Quebec Street
Englewood, Colorado 80111
Tel : (303) 889-6545
Fax : (303) 773-8420
Email : zeiger@uswat.uswest.com or zeiger@uswest.com

Affiliation : Vermont Technical College

Membership : Principal
Name : Peter Chapin
Address : Vermont Technical College
Randolph Center, Vermont 05061
Tel : (802) 728-3391
Fax :
Email : petercc@uvmvax.uvm.edu

Affiliation : Wang Information Services

Membership : Principal
Name : Bruce S. Tannenbaum
Address : Wang Laboratories, Inc.
One Industrial Avenue, M/S 011-310
Lowell, MA 01851
Tel : (508) 967-7577
Fax :
Email : Bruce.Tannenbaum@OFFICE.WANG.COM

Membership : Alternate

Name : Lucy Van Leeuwen

Address : same as above

Tel : (508) 967-4834

Fax : (508) 453-5795

Email :

Affiliation : WATCOM

Membership : Principal

Name : Anthony Scian

Address : WATCOM

415 Phillip Street

Waterloo, Ontario

Canada N2L 3X2

Tel : (519) 886-3700

Fax : (519) 747-4971

Email : afscian@watmsg.waterloo.edu

Membership : Alternate

Name : Fred Crigger

Address : same as above

Tel : (519) 886-3700

Fax : (519) 747-4971

Email : Fred.Crigger@f186.n221.z1.fidonet.org

Affiliation : Zortech

Membership : Principal

Name : Samuel Druker

Address : Zortech

4-C Gill St.

Woburn, MA 01801

Tel : (617) 937-0696

Fax : (617) 937-0793

Email : maxsmith@athena.mit.edu

Membership : Alternate

Name : Robert Swarm

Address : same as above

Tel : (617) 937-0696

Fax : (617) 643-7969

Email : swarm@zurich.ai.mit.edu

Affiliation : Representing self *

Membership : Principal

Name : Ronald F. Guilmette

Address : 396 Ano Nuevo Ave. #216

Sunnyvale, CA 94086

Tel : (415) 691-2114

Fax :

Email : rfg@ncd.com

Members whose voting rights are suspended due to nonattendance

Affiliation : AGS Information Services, Inc.

Membership : Principal

Name : John R. Gidman

Address : AGS Information Services, Inc.

18 Foster Dr.

Willimantic, CT 06226

Tel : (203) 423-2014

Fax :

Email :

Affiliation : American International Group

Membership : Principal

Name : Wahhab Baldwin

Address : American International Group

340 Granite St.

Manchester, NH 03102

Tel : (603) 624-9020

Fax : (603) 624-9196

Email : attmail!wbaldwin

Affiliation : ARIX Corporation

Membership : Principal

Name : Hossein Raassi

Address : ARIX Corporation

821 Fox Lane

San Jose, CA 95131

Tel : (408) 922-1762

Fax :

Email : sun.com!arete!ice!hossein or arete!castra!hossein@Sun.COM

Affiliation : Dlugosz Software

Membership : Principal

Name : John Dlugosz
Address : Dlugosz Software
P.O. Box 867506
Plano, TX 75086
Tel : (214) 985-8098
Fax :
Email :

Affiliation : MicroWay, Inc.

Membership : Principal
Name : Mark Barrenechea
Address : MicroWay, Inc.
Bldg. 20, Cordage Park
Plymouth, MA 02361
Tel : (508) 746-7341
Fax : (508) 746-4678
Email :

Affiliation : Object Design

Membership : Principal
Name : Sam Haradhvala
Address : Object Design
1 New England Executive Park
Burlington, MA 01803
Tel :
Fax :
Email : sam@odi.com

Affiliation : Ontologic, Inc.

Membership : Principal
Name : Tim Andrews
Address : Ontologic, Inc.
Three Burlington Woods
Burlington, MA 01803
Tel : (617) 272-7110
Fax : (617) 272-8101

Email : uunet!uupsi!ontologic!andrews

Membership : Alternate

Name : Robert Martin

Address : same as above

Tel :

Fax :

Email :

Affiliation : Saber Software

Membership : Principal

Name : Mike Dieter

Address : Saber Software

185 Alewife Brook Parkway

Cambridge, Ma 02138

Tel : (617) 876-7636

Fax : (617) 547-9011

Email : dieter@saber.com

Membership : Alternate

Name : Dave Reed

Address : same as above

Tel : (617) 876-7636

Fax : (617) 547-9011

Email : drr@saber.com

Affiliation : Team One Consulting

Membership : Principal

Name : Christopher Glaeser

Address : 34099 Webfoot Loop

Fremont, CA 94555

Tel : (415) 790-2630

Fax : (415) 790-2841

Email : cdg@cup.portal.com

Affiliation : Representing self

Membership : Principal
Name : P.J. Plauger
Address : 398 Main St.
Concord, MA 01742
Tel : (508) 369-8489
Fax : (508) 369-8796
Email : uunet!plauger!pjp

Observer members

Affiliation : ALCATEL CIT, PNS Division OML

Membership : Observer

Name : Aline Scortesse

Address : ALCATEL CIT, PNS Division OML

2, rue Luis de Broglie, BP 344

22 304 Lannion

France

Tel : (33) 96.05.45.07

Fax : (33) 96.05.52.85

Email :

Affiliation : British Aerospace (Dynamics) Ltd.

Membership : Observer

Name : Mike Heley

Address : British Aerospace (Dynamics) Ltd.

PB 230, PO Box 19

Six Hills Way

Stevenage, SG1 2DA

United Kingdom

Tel : +44 438 752432

Fax : +44 438 75337

Email : mike@ste.dyn.bae.co.uk

Membership : Observer

Name : Adam Curtin

Address : same as above

Tel : +44 438 753430

Fax : +44 438 75337

Email : adam@ste.dyn.bae.co.uk

Affiliation : British Embassy

Membership : Observer

Name : William Hill

Address : British Embassy
35, rue du Faubourg Saint-Honoré 202
75383 Paris Cedex 08
France
Tel : +42 66 91 42
Fax :
Email :

Affiliation : Bull HN

Membership : Observer
Name : John W. Gintell
Address : Bull HN MS821A
300 Concord Road
Billerica, MA 01821
Tel : (508) 294-7225
Fax :
Email : gintell@granite.cr.bull.com

Affiliation : The C++ Journal

Membership : Observer
Name : Livleen Singh
Address : The C++ Journal
2 Haven Avenue
Port Washington, NY 11050
Tel : (516) 767-7107
Fax :
Email :

Affiliation : Calma - A Division of Prime Computer

Membership : Observer
Name : Walter L. Peterson, Jr.
Address : Calma
9805 Scranton Road
San Diego, CA 9212
Tel : (619) 587-3195
Fax : (619)-452-8942

Email : wlp@calmasd.prime.com

Affiliation : Cray Research, Inc.

Membership : Observer

Name : David Whitney

Address : Cray Research, Inc.

655-E Lone Oak Road

Eagan, Minnesota 55121

Tel :

Fax :

Email : dew@cray.com

Affiliation : Danish UNIX User Group

Membership : Observer

Name : Keld Simonsen

Address : Danish UNIX User Group

Studivstraede 6

DK-1455 Copenhagen K

DENMARK

Tel : +45 33 13 00 23

Fax : +45 33 91 18 28

Email : keld@dkuug.dk

Affiliation : Datap Systems

Membership : Observer

Name : Doug Konkin

Address : Datap Systems, Tenth Floor

940 Sixth Avenue

Calgary, Alberta

Canada (?)

Tel : +1 403 237-9500

Fax :

Email : doug@noah.arc.ab.ca

Affiliation : DDC International A/S

Membership : Observer
Name : Jorgen Bundgaard
Address : DDC International A/S
GL. Lundtoftevej 1B
DK-2800 Lingby
Denmark
Tel : +45 45 87 11 44
Fax : +45 45 87 22 17
Email :

Affiliation : Edinburgh Portable Compilers, Ltd.

Membership : Observer
Name : Eileen Baxter
Address : Edinburgh Portable Compilers, Ltd.
17 Alva Street
Edinburgh EH2 4PH
United Kingdom
Tel : 031-225 6262
Fax : 031-225 6644
Email :

Affiliation : Edison Design Group

Membership : Observer
Name : J. Stephen Adamczyk
Address : Edison Design Group
4 Norman Road
Upper Montclair, NJ 07043
Tel : (201) 744-2620
Fax : (201) 744-8949
Email : jsa@edg.com

Membership : Observer
Name : Mike Anderson
Address : Edison Design Group
8 Orchard View Drive
Wilton, NH 03086
Tel : (603) 654-5047

Fax : (603) 654-5581
Email : rma@edg.com

Affiliation : EDP News Services

Membership : Observer
Name : Henry HeFFernan
Address : EDP News Services
19 Eye St., N.W.
Washington, D.C. 20001
Tel : (202) 789-1880
Fax :
Email :

Affiliation : Electronics & Telecommunications Research Institute

Membership : Observer
Name : Han Namgoong
Address : ETRI, System Software Section
P. O. Box 8
Daedong Danji
Daejeon, 305-605
Korea
Tel : +82-42-820-6637
Fax : +82-42-861-1033
Email : nghan@kiet.etri.re.kr or
uunet!halla!sorak!kiet!nghan

Affiliation : Ellemtel Utvecklings AB

Membership : Observer
Name : Erik Nyquist
Address : Ellemtel Utvecklings AB
Box 1505
S-125 25 \216lvsj\224
Sweden
Tel : +46 8 727 30 32
Fax : +46 8 47 82 76
Email : Erik.Nyquist@eua.ericsson.se

Affiliation : Green Hills Software

Membership : Observer

Name : Craig Franklin

Address : Green Hills Software

510 Castillo Street

Santa Barbara, CA 93101

Tel : (805) 965-6044

Fax : (805) 965-6343

Email :

Affiliation : Industrieanlagen-Betriebsgesellschaft mbH

Membership : Observer

Name : Rainer Midderhoff

Address : Industrieanlagen-Betriebsgesellschaft mbH

Dept. ITE (Software Technology)

Einsteinstra\341e 20

D-8012 Ottobrunn

Germany

Tel :

Fax :

Email : uunet!unido!iabgsz!sztsun02!midd

Affiliation : Insight Resource, Inc.

Membership : Observer

Name : Christopher Skelly

Address : Insight Resource, Inc.

175 Prospect Avenue

Tarrytown, NY 10591

Tel : Tel: (914) 332-1589

Fax :

Email :

Affiliation : The Instruction Set

Membership : Observer

Name : Mike Banahan
Address : The Instruction Set
City House
190-192 City Road
London EC1V 2QH
UK
Tel : +44-71-251-2128
Fax : +44-71-251-2853
Email : mikeb@inset.co.uk

Affiliation : International Computers, Ltd.

Membership : Observer
Name : John C. Moor
Address : International Computers, Ltd.
Lovelace Road
Bracknell, Berkshire RG12 4SN
United Kingdom
Tel : +44 344 424842
Fax : +44 344 487832
Email : jcm@oasis.icl.stc.co.uk

Affiliation : Journal of C Language Translation and NCEG

Membership : Observer
Name : Rex Jaeschke
Address : Journal of C Language Translation
2051 Swans Neck Way
Reston, Virginia 22091
Tel : (703) 860-0091
Fax :
Email : uunet!aussie!rex

Affiliation : Language Technology

Membership : Observer
Name : Mark J. Sontz
Address : Language Technology
27 Congress Street

Salem, MA 01970
Tel : (508) 741-1507
Fax :
Email :

Affiliation : Los Alamos National Laboratory

Membership : Observer
Name : David W. Forslund
Deputy Director, Adv Computing Lab
Address : Los Alamos Nat'l Laboratory, MS B287
Los Alamos, NM 87545
Tel : (505) 665-1907
Fax :
Email : dwf@lanl.gov

Affiliation : McAdams, Roux and Associates, Inc.

Membership : Observer
Name : John D. Lorimer
Address : McAdams, Roux and Associates, Inc.
1225 17th Street, Ste. 2000
Denver, CO 80202
Tel : (303) 295-1934
Fax : (303) 294-0024
Email :

Affiliation : Microware Systems Corporation

Membership : Observer
Name : Richard Russell
Address : Microware Systems Corp.
1900 N.W. 114th Street
Des Moines, IA 50322
Tel :
Fax :
Email :

Affiliation : MIPS Computer Systems, Inc.

Membership : Observer

Name : Shin-Ming Liu

Address : MIPS Computer Systems, Inc.

Mail Stop #1-03

928 Arques Avenue

Sunnyvale, CA 94086

Tel :

Fax :

Email : shin@mips.com

Affiliation : Electrotechnical Laboratory, MITI

Membership : Observer

Name : Yutaka Ishikawa

Address : Computer Language Section

Electrotechnical Laboratory, MITI

1-1-4 Umezono, Tsukuba, Ibaraki, 305

Japan

Tel :

Fax :

Email : yisikawa@etl.go.jp

Affiliation : Northrop Research and Technology Center

Membership : Observer

Name : Ian Angus

Address : Northrop Research and Technology Ctr

One Research Park

Rolling Hills Estates, CA 90274

Tel : (213) 544-5210

Fax : (213) 377-4271

Email : iangus@nrtc.northrop.com

Affiliation : Que Corporation

Membership : Observer

Name : Allen L. Wyatt
Address : Que Corporation
11711 North College Avenue
Carmel, Indiana 46032
Tel : (317) 573-2570
Fax : (317) 573-2583
Email :

Affiliation : Samsung Software America

Membership : Observer
Name : Joseph Fialli
Address : Samsung Software America
One Corporate Drive
Andover, MA 01810
Tel : (508) 685-7200
Fax : (508) 685-4940
Email :

Affiliation : Sandia National Laboratories

Membership : Observer
Name : R. Charleene Lennox
Address : Sandia National Laboratories, Div 1414
Albuquerque, NM 87185
Tel : (505) 846-0808
Fax :
Email : rclenno@sandia.gov

Affiliation : Scientific Software Engineering, Inc.

Membership : Observer
Name : Mark S. Dailey
Address : Scientific Software Engineering, Inc.
1426 Buchanan Street
Novato, CA 94947-4403
Tel : (415) 898-2316
Fax :
Email :

Affiliation : Sequent Computer Systems, Inc.

Membership : Observer

Name : Paul E. McKenney

Address : Sequent Computer Systems, Inc.

15450 SW Koll Parkway

Beaverton, OR 97006

Tel :

Fax :

Email : mckenney@sequent.com

Affiliation : Siemens Nixdorf

Membership : Observer

Name : Roland Hartinger

Address : Siemens Nixdorf Informationssysteme AG

Postfach 830951 Otto-Hahn-Ring 6

W-8000 M201nchen 83

Germany

Tel : (089) 636-44081

Fax : (089) 636-40140

Email : uunet!unido!sinix!athen!d015S000!hartinger

Affiliation : Simpack Associates, Inc.

Membership : Observer

Name : Tom Provenzano

Address : Simpack Associates, Inc.

12007 Sunrise Valley Dr.

Reston, VA 22091

Tel :

Fax :

Email : 71631.560@CompuServe.COM

Affiliation : softeam GmbH

Membership : Observer

Name : Michael D204umling

Address : softeam GmbH
An der Bahn 17
2126 Adendorf
Germany
Tel : +49-4131-187411
Fax : +49-4131-187412
Email : 73477.2366@compuserve.com

Affiliation : SoftSys Consulting AB

Membership : Observer
Name : Pelle Berg
Address : SoftSys Consulting AB
P. O. Box 1447
S-183 14 T204by
Sweden
Tel : +46-8-732 84 65
Fax : +46-8-732 45 38
Email :

Affiliation : Stratus Computer, Inc.

Membership : Observer
Name : David Toland
Address : Stratus Computer, Inc.
55 Fairbanks Blvd.
Marlboro, MA 01752
Tel :
Fax :
Email :

Affiliation : Tandem Computers, Inc.

Membership : Observer
Name : Elaine Gord
Address : Tandem Computers, Inc. 100-05
10555 Ridgeview Court
Cupertino, CA 95014-0789
Tel : (408) 285-0858

Fax :
Email :

Membership : Observer
Name : Brian Laschkewitsch
Address : Tandem Computers, Inc.
10100 N. Tantau Ave. LOC 251-37
Cupertino, CA 95014-2542
Tel : (408) 285-2200
Fax :
Email :

Affiliation : Treasury Board Canada

Membership : Observer
Name : Joseph Cote
Address : Treasury Board Canada
140 O'Connor Street, 10th floor
Ontario K1A0R5
Canada
Tel : (613) 996-2690
Fax : (613) 957-2496
Email :

Affiliation : The Waite Group

Membership : Observer
Name : Mitchell Waite
Address : The Waite Group
100 Shoreline Highway, Suite 285
Mill Valley, CA 94941
Tel : (415) 331-0575
Fax : (415) 331-1075
Email : mitch@well.sf.ca.us

Affiliation : Representing self

Membership : Observer
Name : John Armstrong

Address : 36 Orchard Street
Cambridge, MA 02140
Tel :
Fax :
Email : joanna@kurz-ai.com

Affiliation : Representing self

Membership : Observer
Name : Jan Bielecki
Address : ul. Narbutta 17 m 21
02-536 Warszawa
Poland
Tel :
Fax :
Email :

Affiliation : Representing self

Membership : Observer
Name : Daniel Edelson
Address : Dept. of Computer Science
University of California
Santa Cruz, CA 95064
Tel : (408) 479-7983
Fax :
Email : daniel@cis.ucsc.edu

Affiliation : Representing self

Membership : Observer
Name : Dr. Hermann Locarek
Address : Schertlinstr. 11 1/8
D-8900 Augsburg
Germany
Tel : +49-821-572039
Fax : +49-821-581478
Email :

Affiliation : Representing self

Membership : Observer

Name : Mark Terribile

Address : Tree Haven III #319B

Matawan, NJ 07747

Tel :

Fax :

Email : uunet!westmark!mole-end!mat

Affiliation : Representing self

Membership : Observer

Name : Garry Vass

Address : Deutsche Bank/Investment Research

Taunusanlage 12

6000 Frankfurt/Main

Germany

Tel : +49 69 7150 8548

Fax :

Email : 72307.3311@CompuServe.COM

ANSI X3J16 list of new applicants

Affiliation : Abraxas Software, Inc.

Membership : ?

Name : Patrick Conley

Address : Abraxas Software

7033 SW Macadam Avenue

Portland, OR 97219

Tel : (503) 244-5253

Fax : (503) 244-8375

Email :

Affiliation : ACDS Syst\212me graphique, inc.

Membership : ?

Name : Connie DesRoche-Gallagher

Address : ACDS Syst\212me graphique, inc.

80, Jean-Proulx

Hull (Qu\202bec) J8Z 1W2

Canada

Tel : (819) 770-9631

Fax : (819) 770-9267

Email :

Affiliation : Aldus Corporation

Membership : ?

Name : Krishna Uppala

Address : Aldus Corp., Dept. Eng.

411 First Ave. S.

Seattle, WA 98104

Canada

Tel :

Fax :

Email : sumax!polari!urk@beaver.cs.washington.edu

Affiliation : ARINC Research Corporation

Membership : Principal

Name : Tom Culliton

Address : ARINC Research Corporation

2551 Riva Road, MS 5-230

Annapolis, MD 21401-7435

Tel : (301) 266-2278

Fax : (301) 266-2047

Email : culliton@srg@uunet.uucp or uunet!culliton@srg

Alternate : Alternate

Name : Bill Havanas

Address : same as above

Tel : (301) 266-2037

Fax : (301) 266-2047

Email : whavanas@srg@uunet.uucp or uunet!whavanas@srg

Affiliation : Bendix Field Engineering Co.

Membership : ?

Name : Dennis M. Kavanagh

Address : Bendix Field Engineering Co.

P. O. Box 241

College Park, MD 20740

Tel :

Fax :

Email :

Affiliation : Cadence Design Systems

Membership : ?

Name : Ken Friedenbach

Address : Cadence Design Systems

555 River Oaks Pkwy, Bldg. 4

San Jose, CA 95134

Tel :

Fax :

Email : kjf@cadence.com

Affiliation : Computer Innovations, Inc.

Membership : Principal

Name : B. Eberhardt

Address : Computer Innovations, Inc.

980 Shrewsbury Ave.

Tinton Falls, NJ 07724-3003

Tel : (201) 542-5920

Fax : (201) 542-6121

Email :

Membership : Alternate

Name : John Chappel

Address : same as above

Tel :

Fax :

Email :

Affiliation : E-Systems

Membership : ?

Name : Stephen R. Davis

Address : E-Systems

P. O. Box 6056

Greenville, TX 75403-6056

Tel : (903) 457-4738

Fax : (903) 457-4413

Email : S_Davis@mcimail.com

Affiliation : FirmWare, Inc.

Membership : ?

Name : Robert Gibson

Address : FirmWare, Inc.

1000 W. McNab Rd.

Pompano Beach, FL 33069

Tel : (305) 941-4000

Fax :
Email :

Affiliation : Fujitsu Limited

Membership : Principal
Name : Masakazu Yamaryo
Address : Fujitsu Numazu Factory
140 Miyamoto, Numazu-shi,
Shizuoka 410-03
Japan
Tel : +81-559-24-7263
Fax : +81-559-24-6174
Email : e1586@utso.nm.fujitsu.co.jp

Membership : Alternate
Name : Chinari Nagashima
Address : same as above
Tel : +81-559-24-7263
Fax : +81-559-24-6174
Email :

Membership : Alternate
Name : Takahiro Ishikawa
Address : same as above
Tel : +81-559-24-7263
Fax : +81-559-24-6174
Email :

Affiliation : Institute for Info Industry

Membership : Principal
Name : Eric Hwang
Address : Institute for Info Industry
444 Castro St., Ste. 816
Mountain View, CA 94041
Tel :
Fax :

Email :

Membership : Alternate

Name : Joe Day

Address : Institute for Info Industry

8th flr, 106 Hoping E. Rd, Sec 2

Taipei, Taiwan

Republic of China

Tel :

Fax :

Email :

Affiliation : Intel Corporation

Membership : Principal

Name : Clark Nelson

Address : Intel Corp., MS JF1-65

5200 NE Elam Young Parkway

Hillsboro, OR 97124

Tel : (503) 696-4589

Fax : (503) 696-4210

Email : clark@clark.intel.com

Membership : Alternate

Name : Atul Gupta

Address : same as above

Tel : (503) 681-8080

Fax :

Email :

Affiliation : Ipse Dixit Software

Membership : ?

Name : David P. Schwartz

Address : Ipse Dixit Software

3333 N. 7th Avenue

Phoenix, AZ 85013-4350

Tel : (602) 274-8850

Fax :

Email :

Affiliation : Lawrence Livermore National Lab

Membership : Principal

Name : Linda Stanberry

Address : Lawrence Livermore National Lab, L-300

P.O. Box 808

Livermore, CA 94550

Tel : 415-422-9006

Fax :

Email : linda@ocfmail.ocf.llnl.gov

Affiliation : NEC Systems Laboratory, Inc.

Membership : Observer

Name : Nobuhiko Kishinoue

Address : NEC Systems Lab, Inc.

10900 NE 8th St., Ste. 900

Bellevue, WA 98004

Tel : (206) 454-9571

Fax : (206) 454-9577

Email : nik@harc.edu

Affiliation : Nokia Research Center

Membership : ?

Name : Hannu Toivonen

Address : Nokia Research Center

P. O. Box 156

SF-02101 Espoo

Finland

Tel : +358 0 4376 393

Fax : +358 0 4552 091

Email :

Affiliation : Nokia Telecommunications

Membership : ?

Name : Pentti Wirta
Address : Nokia Telecommunications
P. O. Box 33
02601 Espoo
Finland
Tel :
Fax :
Email : wirta@tele.nokia.fi

Affiliation : ParcPlace Systems

Membership : Principal
Name : Alan Sloane
Address : ParcPlace Systems
1550 Plymouth Street
Mountain View, CA 94043
Tel : (415) 691-6752
Fax : (415) 691-6715
Email : sloane@ParcPlace.COM

Membership : ?
Name : Greg Ching
Address : same as above
Tel : (415) 691-6702
Fax : (415) 691-6715
Email : greg@ParcPlace.COM

Affiliation : Pitney-Bowes

Membership : ?
Name : Charles Heaton, Jr.
Address : Pitney-Bowes
302 West Flat Hill Road
Southbury, CT 06488
Tel : (203) 925-5180
Fax : (203) 925-5333
Email :

Affiliation : QA Training, Ltd.

Membership : ?

Name : Robert A. Seeman

Address : QA Training, Ltd.

Cecily Hill Castle

Cirencester

Gloucestershire GL7 2EF

United Kingdom

Tel : +44 285 655888

Fax : +44 285 640181

Email :

Affiliation : Radiophysics, Inc.

Membership : Principal

Name : David Evans

Address : Radiophysics, Inc.

5475 Western Ave.

Boulder, CO 80301

Tel :

Fax :

Email : devans@orion.colorado.edu

Affiliation : Software Technology Transfer, Ltd.

Membership : ?

Name : David Bern

Address : Software Technology Transfer, Ltd.

P. O. Box 4186

Warren, NJ 07060

Tel : (201) 668-1593

Fax :

Email : bern%sttl@uunet.uu.net

Affiliation : Software Truth

Membership : ?

Name : Steven Kearns
Address : Software Truth
7447 Draper Ave. #A
La Jolla, CA 92037
Tel :
Fax :
Email : uunet!softrue!kearns or softrue!kearns@uunet.uu.net

Affiliation : Source Maverick

Membership : ?
Name : Hank Blake
Address : Source Maverick
6260 Childs Avenue
San Diego, CA 92139
Tel : (619) 267-3383
Fax : (619) 470-6916
Email :

Affiliation : Symphony Software Corp.

Membership : ?
Name : D. Jeffrey Hoffman
Address : Symphony Software Corp.
110 Coliseum Ave., Suite 305
Nashua, NH 03063
Tel : (603) 595-1613
Fax :
Email :

Affiliation : University of Illinois

Membership : ?
Name : Stephen Parkes
Address : Coordinated Science Laboratory
University of Illinois
1101 W. Springfield
Urbana, IL 61801
Tel :

Fax :

Email : steven@uicadd.csl.uiuc.edu

Affiliation : University of Ottawa

Membership : ?

Name : Martin Hitz

Address : University of Ottawa

Computer Science Dept.

34 George Glinski

Ottawa K1N 6N5

Canada

Tel : (613) 235-1094

Fax :

Email : hitz%sim1@uotcsi2.bitnet or hitz@sim1.csi.uofa.edu

Affiliation : Representing self

Membership : ?

Name : Scott L. Burson

Address : 447 Alta Ave.

Santa Cruz, CA 95060

Tel :

Fax :

Email : gyro@cymbal.reasoning.com

Affiliation : Representing self

Membership : ?

Name : Alex X. Gares

Address : 601 Prairie Lake Drive

Fern Park, FL 32730

Tel :

Fax :

Email :

Affiliation : Representing self

Membership : ?

Name : Lawrence Harris
Address : 395-19G South End Ave.
New York, NY 10280
Tel : (212) 466-4865
Fax :
Email :

Affiliation : Representing self

Membership : ?
Name : Raymond Hettinger
Address : 1701 Malcolm Ave. #5
Los Angeles, CA 90024
Tel :
Fax :
Email :

Affiliation : Representing self

Membership : ?
Name : Tamura Jones
Address : P. O. Box 11258
2301 EG Leiden
The Netherlands
Tel : +31 71 134945
Fax :
Email : jolink@hlerul5.bitnet

Affiliation : Representing self

Membership : ?
Name : Joseph M. Newcomer
Address : 610 Kirtland St.
Pittsburgh, PA 15208
Tel : (412) 243-8492
Fax : (412) 244-0922
Email :

Affiliation : Representing self

Membership : ?

Name : Daniel M. Wasserburg

Address : 30 Magaw Place, 4C

New York, NY 10033

Tel : (212) 928-8962

Fax :

Email :

Affiliation : Representing self

Membership : ?

Name : Ian G. Zahn

Address : 865 S. 33rd Street

Lincoln, NE 68510

Tel :

Fax :

Email :

Appendix E - Status of Training and Education

C++ Education and Training

C++ Training

Provider	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
1 Mark V Systems, Ltd	In-house and hands-on training in C++	16400 Ventura Blvd. Ste 303	Encino	California	91436	Mo Bjornestad	818-995-7671
2 ParcPlace Systems, Inc.	Intro to Object-Oriented Concepts and C++ - 5 day course taught in-house (\$1400/person) or at the customer site (\$15000 for up to 10 students, additional \$1200 each with max of 20)	1550 Plymouth Street	Mountain View	California	94043	Debbie Hudson	415-691-6755
3 Santa Clara University	C++		Santa Clara	California			
4 Rational Consulting	1-Design workshop - 6 session (5 2-day sessions & wrap-up session) for 12 students (\$30,000) 2- Intro course - 1 week (\$12,500) 3- Adv course - 1 week (\$12500)	3320 Scott Boulevard	Santa Clara	California	95054	Brock Peterson	408-496-3684
5 Hewlett-Packard	Public seminars, in-house training and hands-on training in C++	1266 Kifer Road	Sunnyvale	California	94086	Jagi Shahani	408-746-5780
6 Versant Object Technology	Public seminars, in-house training and hands-on training in C++	4500 Bohannon Drive	Menlo Park	California		Sandra Philpott	415-325-2380
7 Fowler Software Design	In-house training and hands-on training in C++	P.O. Box 365	Eldorado Springs	Colorado	80025	Jan Fowler	303-494-5755
8 Florida Institute of Technology	C++ courses available in 1992	Department of CS 150 West University Blvd	Melbourne	Florida	32901	Charles Engle	407-768-8000

C++ Training

	Provider	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
9	Capital College	1-Object Oriented Programming 2-Advanced C course		Laurel	Maryland		Jack Bieler Harry Harrison	703-941-8888 301-953-0060
10	Object Design Support Services (training facil. in Mass and CA)	1-Intro to OOP and C++ (2 days, \$695/person with max of 10 people) 2-Mastering C++ (2 days, \$695/person with max of 10 people) All course available on-site or at training centers	One New England Exec Park	Burlington	Massachusetts	1803	Cheryl Fiust	617-270-9797 ext. 132
11	Technology Exchange Co./Addison-Wesley	Public seminars, in-house training and hands-on training in C++	Rte 128	Reading	Massachusetts	1867		800-333-0088 617-944-3700
12	MacGregor Group	In-house C++ training	34 Summit Road	Wellesley	Massachusetts	2181	Steven Levy	Phone number changed-now unlisted
13	Empathy (All training at customer site)	1-OOP using C++ (4 days, max 20 people, \$9,900) 2-Advanced C++ and Design Techniques (4 days, max 20 people, \$9,900) 3- OOD (3 days, max 20 people, \$7,900)	P.O. Box 632	Cambridge	Massachusetts	2142	Rich Mitchell	617-787-3089
14	Semaphore Training	1- Introduction to C++ and OOD (5 days at \$11,495 for 15 people - incl lab) 2-Efficient Impl of OOD in C++ 3-Advanced C++ & OOD (4 days at \$10,995 for 15 people - incl. lab)	800 Turnpike Street, Suite 200	North Andover	Massachusetts	1845	Ted Cannie	508-794-3366
15	Object Resources	In process of developing C++ courses and will customize courses for the customer as needed	39500 14 Mile Road, Suite 206	Walled Lake	MI	48088	John Killis	313-661-5343
16	Arbor Intelligent Systems, Inc.	C++ Training on the MAC - Introduction and Advance courses that run 5 days for approximately \$1400/person. Will do on site-training and develop C++ course for platform other than MAC		Ann Arbor	Michigan		Ron Suarez	313-996-4238

	Provider	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
17	Invention Software	Public seminars, in-house training and hands-on training in C++	P.O. Box 3168	Ann Arbor	Michigan	48106	Mike Davidson	Phone disconnected
18	EDP Consultants, Inc.	In-house and hands-on training in C++	77 Meredith Road	Colonia	New Jersey	7067	Richard Estock	
19	Institute for Zero Defect Software	Both courses taught at customer site: 1-C++ Prog for C Programmers (5 day hands-on workshop, \$8500)(16 people) 2-OO Design for C++ (5 day hands-on workshop, \$8500) (max 16 people)	85 Poplar Drive	Sterling	New Jersey	7980	Hwe-Chu Tu	201-604-8701
20	DeerWorks	1-Intro to C++ and OOD - 4 days hands-on course (\$2,000/day at customer site, \$350/person public seminar) 2-OOD mapped into C++ - 3 day course with case studies (same price)	411 Valentine Street	Highland Park	New Jersey	8904	Tsvi Bar-David	201-985-7427
21	Center for Object-Oriented Training	1-Stepping Up from C to C++ 2-Advanced programming in C++	588 Broadway, #604	New York	New York	10012	Melanie Younossi	212-274-0640
22	ImageSoft	5 day lab-intensive C++ course taught at the New York Office or on-site. \$1750/student with max of 15 people. Fee includes notes, and 2 textbooks	2 Haven Ave	Port Washington	New York	11050	Ramana Murthy	516-767-2233 800-245-8840
23	Saks & Associates	In-house training and hands-on training in C++	287 W. McCreight Avenue	Springfield	Ohio	45504	Dan Saks	513-324-3601
24	Quality Software Engineering	1-C++: Programming, Paradigms and Techniques (4 days, hands-on lab) 2-Structured Approach to OOD (4 days, hands-on lab) All courses \$2,000/day for up to 20 students	P.O. Box 303	Beaverton	Oregon	97075	Paul Blattner	503-538-8256

C++ Training

	Provider	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
25	Instantiations	On-site courses that consist of 2 days of OOD and 3 days of programming using C++. If hands-on course, is limited to 14 people, if not, course limited to 20. \$10,000 + instructor's expenses		Portland	Oregon		Leslie Menashe	503-242-0725
26	Revolution 2	In-house training and hands-on training in C++	P.O. Box 760	Kenneth Square	Pennsylvania	19348	Bruck Eckel	Phone disconnected
27	Object International, Inc.	Public seminars, in-house training and hands-on training in C++	9430 Research Blvd. IV-400	Austin	Texas	78759	Sylvia Owens	512-343-4549
28	Genesis Development Corp.	Public seminars and in-house training in C++	1303 Columbia Dr., Ste 209	Richardson	Texas	75081	Susan Estes	214-644-8559
29	George Washington University	1-Software Engineering (in Fall 91) 2-Software Engineering - graduate level	Computer Science Department		Washington D.C.		Shmuel Rotenstreich	202-994-5252

Commerically Available Ada Courses

1	Telesoft	Introduction to Ada - comprehensive series of new Ada training targeting large-scale and embedded real-time programming issues.	5959 Cornerstone Court West	San Diego	CA	92121	Jeff Kelley	619-457-2700
2	Systems Engineering Research Corporation	Advanced Ada Topics Series - includes several Ada topics and language issues	415 Clyde Avenue Suite D	Mountain View	California	94043		415-962-8092
3	Ada Technology Group	Ada Software Engineering for Defense Systems - 10 day hands on program on Ada	1900 L. Street, Suite 500	Washington	D.C.	20036	Walter Rollins	202-296-1321
4	Integrated Software	Ada For Real-Time Systems - a two day seminar that addresses the practical considerations of real-time programming in Ada. (\$4000 - may include up to 25 attendees)	P.O. Box 060295	Palm Bay	Florida	32906	Marilyn Pelo	407-984-1986
5	Advanced Software Technology Specialists	Ada Design and Coding: 1- 5 days (\$11000) [All courses are taught at the customer's site]	4 Lutz Road	Ossian	Indiana	46777	Donald G. Firesmith	219-639-6305
6	Advanced Software Technology Specialists	Ada Design and Coding: 2 - 5 days (\$1100)	4 Lutz Road	Ossian	Indiana	46777	Donald G. Firesmith	219-639-6305
7	Advanced Software Technology Specialists	Ada Design and Coding: 3 - 5 days (\$1100)	4 Lutz Road	Ossian	Indiana	46777	Donald G. Firesmith	219-639-6305
8	Advanced Software Technology Specialists	Ada Project Management - 4 days (\$12500)	4 Lutz Road	Ossian	Indiana	46777	Donald G. Firesmith	219-639-6305
9	Advanced Software Technology Specialists	Ada Technology Transition - An Executive Overview - 1 day (\$3000)	4 Lutz Road	Ossian	Indiana	46777	Donald G. Firesmith	219-639-6305

Commerically Available Ada Courses

10	Advanced Software Technology Specialists	Ada Testing, Quality Assurance and IV&V - 3 days (\$7000)	4 Lutz Road	Ossian	Indiana	46777	Donald G. Firesmith	219-639-6305
11	Advanced Software Technology Specialists	Ada Tools and Environments - 2 days (\$5500)	4 Lutz Road	Ossian	Indiana	46777	Donald G. Firesmith	219-639-6305
12	Advanced Software Technology Specialists	DoD-STD-2167A and Tailoring for Ada Projects - 2 days (\$5500)	4 Lutz Road	Ossian	Indiana	46777	Donald G. Firesmith	219-639-6305
13	Advanced Software Technology Specialists	Object-Oriented Development in Ada - 5 days (\$12500)	4 Lutz Road	Ossian	Indiana	46777	Donald G. Firesmith	219-639-6305
14	Advanced Software Technology Specialists	Object-Oriented Requirements Analysis - 1 day (\$3000)	4 Lutz Road	Ossian	Indiana	46777	Donald G. Firesmith	219-639-6305
15	Advanced Software Technology Specialists	Software Economics in Ada - 2 days (\$5500)	4 Lutz Road	Ossian	Indiana	46777	Donald G. Firesmith	219-639-6305
16	Advanced Software Technology Specialists	Software Engineering and Methods in Ada - 2 days (\$5500)	4 Lutz Road	Ossian	Indiana	46777	Donald G. Firesmith	219-639-6305
17	Fastrak Training, Inc.	Ada - Management Perspective - a 3 day seminar for managers and senior technical staff - available upon request	9175 Guilford Road, Suite 300	Columbia	Maryland	21046	Abby Eden	301-498-5601
18	Fastrak Training, Inc.	Ada Cost Modeling - one day seminar designed for technical managers and staff responsible for estimating size, effort and schedule on Ada software development projects	9175 Guilford Road, Suite 300	Columbia	Maryland	21046	Abby Eden	301-498-5601

Commerically Available Ada Courses

19	Fastrak Training, Inc.	Advanced Ada Programming - 5 day hands on workshop created for software engineers with previous Ada experience and/or training - available upon request	9175 Guilford Road, Suite 300	Columbia	Maryland	21046	Abby Eden	301-498-5601
20	Fastrak Training, Inc.	Designing Ada Software - 4 day workshop for programmers and software designers to introduce a methodical design process for OOD in a 4-step approach	9175 Guilford Road, Suite 300	Columbia	Maryland	21046	Abby Eden	301-498-5601
21	Fastrak Training, Inc.	Evaluating Ada Code - 5 day seminar designed for government personnel and IV&V contractors who read and evaluate compiled Ada PDL or code - available upon request	9175 Guilford Road, Suite 300	Columbia	Maryland	21046	Abby Eden	301-498-5601
22	Fastrak Training, Inc.	Introduction to Ada Programming - 5 day hands-on workshop for software engineers with no prior experience programming in Ada - available upon request	9175 Guilford Road, Suite 300	Columbia	Maryland	21046	Abby Eden	301-498-5601
23	Fastrak Training, Inc.	Software Engineering in the Ada Environment - 4 day seminar for technical staff participating in Ada software development and maintenance for large systems	9175 Guilford Road, Suite 300	Columbia	Maryland	21046	Abby Eden	301-498-5601
24	EVB Software Engineering, Inc.	Advanced Ada Programming Workshop - 5 day seminar designed for programmers, analysts, and managers (\$10,000)	5320 Spectrum Drive	Frederick	Maryland	21701	Jennifer Lott Ann Hawkins	301-695-6960
25	EVB Software Engineering, Inc.	Creating Reusable Ada Software - 5 day seminar for technical software professionals with a reading knowledge of Ada (\$10,000)	5320 Spectrum Drive	Frederick	Maryland	21701	Jennifer Lott Ann Hawkins	301-695-6960
26	EVB Software Engineering, Inc.	Fundamental Object Oriented Concepts - 5 day seminar for those interested in an OOD approach to Ada software developing (\$10,000)	5320 Spectrum Drive	Frederick	Maryland	21701	Jennifer Lott Ann Hawkins	301-695-6960
27	EVB Software Engineering, Inc.	Object Oriented Development for Ada Software - 5 day seminar intended for software engineers and technical managers using OOD as a methodology for Ada development (\$10,000)	5320 Spectrum Drive	Frederick	Maryland	21701	Jennifer Lott Ann Hawkins	301-695-6960

Commerically Available Ada Courses

28	EVB Software Engineering, Inc.	Testing Ada Software - 3 day seminar for programmers, analysts and managers who are interested in various software testing techniques and strategies (\$6000)	5320 Spectrum Drive	Frederick	Maryland	21701	Jennifer Lott Ann Hawkins	301-695-6960
29	IIT Research Institute	Ada For Managers - 4 hour course - explore philosophy of Ada and maximizing benefits (\$800 - up to 10 students)	4600 Forbes Blvd.	Lanham	Maryland	20706	Ms. Mary Armstrong	301-731-8894
30	IIT Research Institute	Ada For Software Engineers - 20 hour discussion and 20 hour hands-on. Provides a summary of syntax and how best to utilize the Ada features. (\$8000 - up to 10 students)	4600 Forbes Blvd.	Lanham	Maryland	20706	Ms. Mary Armstrong	301-731-8894
31	IIT Research Institute	Executive Overview of Ada - 2 hour discussion of the types of contracts an Ada software lab can expect to acquire and the up-front investments that must be made (\$400)	4600 Forbes Blvd.	Lanham	Maryland	20706	Ms. Mary Armstrong	301-731-8894
32	IIT Research Institute	Object-Oriented Development in Ada - 10 hours discussion and 30 hours hands-on. Introduce the software engineer to state-of-the-art software development theory (\$8000 - up to 10 students)	4600 Forbes Blvd.	Lanham	Maryland	20706	Ms. Mary Armstrong	301-731-8894
33	IMR Systems Corp	Ada Training Laboratory - training focuses on software development and compliance with DoD standards - lab has a validated Ada compiler and Ada development environment	11400 Rockville Pike, Suite 501	Rockville	Maryland	20852	Mr. Will Spencer	301-468-1160
34	Alays Inc. - courses taught at customer site for up to 20 students	Ada Software Engineering Design Methodologies - 5 day seminar for those who need to understand how Ada can best be used and how to establish a coherent Ada-based methodology	14 Main Street	Waltham	Massachusetts	2154	Dr. Benjamin M. Brosgol	617-890-0030
35	Alays Inc. - courses taught at customer site for up to 20 students	Ada Software for Managers - 3 day seminar on the management issues of Ada use for large systems development	14 Main Street	Waltham	Massachusetts	2154	Dr. Benjamin M. Brosgol	617-890-0030
36	Alays Inc. - courses taught at customer site for up to 20 students	Ada Technology Issues - 2 1/2 day seminar for the computer executive who needs to know what the advantages, risks, etc. are in choosing Ada for software development	14 Main Street	Waltham	Massachusetts	2154	Dr. Benjamin M. Brosgol	617-890-0030

Commerically Available Ada Courses

37	Alsys Inc. - courses taught at customer site for up to 20 students	Advanced Ada Topics and Real-Time Systems in Ada - 7 day seminar for those who need to understand possible peculiarities of Ada real-time systems.	14 Main Street	Waltham	Massachusetts	2154	Dr. Benjamin M. Brosgol	617-890-0030
38	Alsys Inc. - courses taught at customer site for up to 20 students	Intermediate Ada - 5 day seminar for those who need to know the strengths and weaknesses of the language in order to design and develop Ada programs.	14 Main Street	Waltham	Massachusetts	2154	Dr. Benjamin M. Brosgol	617-890-0030
39	Alsys Inc. - courses taught at customer site for up to 20 students	Introduction to the Ada Language - one day seminar for software project managers or others who wish a broad view of Ada and its implications.	14 Main Street	Waltham	Massachusetts	2154	Dr. Benjamin M. Brosgol	617-890-0030
40	Alsys Inc. - courses taught at customer site for up to 20 students	Introductory Ada - 5 day seminar for software engineers, etc. who need to become familiar with Ada and its features in order to write Ada programs	14 Main Street	Waltham	Massachusetts	2154	Dr. Benjamin M. Brosgol	617-890-0030
41	SoftTech	Ada for Software Managers - 3 day presentation of Ada's in its entirety from the viewpoint of a technical manager	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900
42	SoftTech	Ada Management Overview for COBOL Background - 4 day course that presents an overview of software engineering in Ada to managers in business applications	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900
43	SoftTech	Ada Orientation for Managers - 1 day overview of Ada's development and features	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900
44	SoftTech	Ada Program Design Language - 3/4/5 day course that teaches how to use Ada program design language (PDL) as a design tool	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900
45	SoftTech	Ada Programming Support Environment Overview - 1 day course that provides an understanding of the complete software development environment	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900

Commercially Available Ada Courses

46	SoiTech	Ada Technical Overview - 1 day overview for software engineers, programmers, system analysts and software engineering managers	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900
47	SoiTech	Ada Technical Overview for COBOL Background - 4 day course that presents a technical overview of software engineering for business applications	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900
48	SoiTech	Advanced Ada Topics- 5/10 day course that teaches modern abstraction concepts and the related facilities of Ada	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900
49	SoiTech	Advanced Ada/Concurrent Processing Topics - 10 day course that introduces advanced techniques in the proper Ada context and Ada design concepts in the context of examples	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900
50	SoiTech	Basic Ada Programming 5/10 day course teaching how to write basic Ada programs	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900
51	SoiTech	Instructor's Course Module - 1 to 5 day course that trains students to become effective instructors.	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900
52	SoiTech	Introduction to Ada - 1 day overview of Ada	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900
53	SoiTech	Introduction to Software Engineering - teaches the fundamental concepts of software engineering to programmers and software designers	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900
54	SoiTech	Programming Methodology - 1 1/2 day course that teaches a practical approach to writing reliable, readable, and maintainable Ada software	460 Totten Pond Road	Waltham	Massachusetts	2254	Ada Training Department	617-890-6900

Commerically Available Ada Courses

55	SoTech	Real-time Concepts - 1 day course teaching approaches to real-time programming	460 Totten Pond Road	Waltham	Massachuse tts	2254	Ada Training Department	617-890-6900
56	SoTech	Real-Time Systems in Ada - 5/10 day course in concepts of concurrent programming.	460 Totten Pond Road	Waltham	Massachuse tts	2254	Ada Training Department	617-890-6900
57	SoTech	Software Engineering for Managers - 1 day course that teches managers modern software engineering concepts	460 Totten Pond Road	Waltham	Massachuse tts	2254	Ada Training Department	617-890-6900
58	SoTech	Software Engineering Methodologies - 5 day course that provides a thorough understanding of software methodologies and how they can be used with Ada	460 Totten Pond Road	Waltham	Massachuse tts	2254	Ada Training Department	617-890-6900
59	SoTech	Systems Engineering Methodology - 3 day course learning to understand systems requirements through the use of structured analysis techniques	460 Totten Pond Road	Waltham	Massachuse tts	2254	Ada Training Department	617-890-6900
60	SoTech	Using the Ada Language Reference Manual - 2 day course to learn how to use the reference manual	460 Totten Pond Road	Waltham	Massachuse tts	2254	Ada Training Department	617-890-6900
61	Texel and Company	Mgt Track - Ada impact Issues (1/2 day), Ada for Technical Management (2 1/2 days), Ada: Bids and Proposal (1 day) and Ada: Software Development Plan (1 day)	Victorial Plaza, 615 Hope Road	Eatontown	New Jersey	7724	Harry Copperthwayte	201-922-6323
62	ADAPLUS, INC.	5 day workshop with lab and lecture taught at customer site (\$20,000/week) Sept 91 have 5 day advanced training course OOD+Ada+Xwindows	P.O. Box 77113	Houston	Texas	77215	Stephen J. Hyland	713-488-1480
63	GHG Corporation	Advanced Ada Language Features - continuation of the introductory course and intended for those who require the utmost in Ada literacy.	1300 Hercules, Suite 111	Houston	Texas	77058	Gary O'Neal	713-488-8806

Commerically Available Ada Courses

64	GHG Corporation	Concurrent Programming In Ada - specialized class that focuses on the anture of concurrent programming and the use of the Ada language in applications.	1300 Hercules, Suite 111	Houston	Texas	77058	Gary O'Neal	713-488-8806
65	GHG Corporation	Embedded/Realtime Programming in Ada - approaches the Ada language from the point of view of embedded real-time systems.	1300 Hercules, Suite 111	Houston	Texas	77058	Gary O'Neal	713-488-8806
66	GHG Corporation	Introduction to High Order Language - provides necessary background material for those who have experience in languages which differ significantly from the Ada language	1300 Hercules, Suite 111	Houston	Texas	77058	Gary O'Neal	713-488-8806
67	GHG Corporation	Introduction to the Ada Language - provides bases for using Ada in a broad class of applications	1300 Hercules, Suite 111	Houston	Texas	77058	Gary O'Neal	713-488-8806
68	GHG Corporation	Programming with X Window System - examines X Window System and focuses on developing Ada software that will run any X Window system environment	1300 Hercules, Suite 111	Houston	Texas	77058	Gary O'Neal	713-488-8806
69	Computer Sciences Corporation	Ada for Project Mangers - 2 day seminar for software development managers (\$4600) Seminar may be presented at customer site	3160 Fairview Park Drive	Falls Church	Virginia	22042	Jeff Seigle	703-876-1438
70	Computer Sciences Corporation	Ada Orientation for Managers - 1/2 day for senior and mid-level managers - non-technical (\$2300) Seminar may be presented at customer site	3160 Fairview Park Drive	Falls Church	Virginia	22042	Jeff Seigle	703-876-1438
71	Computer Sciences Corporation	Ada Technical Overview - 2 day seminar for people with experierc in a high-level language and have had some exposure to Ada (\$4600) Seminar may be presented at customer site	3160 Fairview Park Drive	Falls Church	Virginia	22042	Jeff Seigle	703-876-1438
72	Computer Sciences Corporation	Advanced Ada Programming - 20 hours of lecture and 20 hours of hands on exercises (\$9500) Seminar may be presented at customer site	3160 Fairview Park Drive	Falls Church	Virginia	22042	Jeff Seigle	703-876-1438

Commerically Available Ada Courses

73	Computer Sciences Corporation	Introductory Ada Programming - 2 week course that introduces the attendee to language features in the context of modern software engineering practices (\$18500) May be a customer's site	3160 Fairview Park Drive	Falls Church	Virginia	22042	Jeff Seigle	703-876-1438
74	Computer Sciences Corporation	Object-Oriented Design with Ada - 4 day workshop illustrating how object-oriented techniques can be used to construct high quality, maintainable Ada software systems(\$7900)	3160 Fairview Park Drive	Falls Church	Virginia	22042	Jeff Seigle	703-876-1438
75	Computer Sciences Corporation	Object-Oriented Requirements Analysis - 4 day workshop (\$7900) (still under development) Workshop may be taught at customer's site	3160 Fairview Park Drive	Falls Church	Virginia	22042	Jeff Seigle	703-876-1438
76	Computer Sciences Corporation	QA and CM for Ada Projects - 3 day workshop under development (\$5900) Workshop may be taught at customer's site	3160 Fairview Park Drive	Falls Church	Virginia	22042	Jeff Seigle	703-876-1438
77	Honeywell Federal Systems, Inc.	Ada Application Programming - 10 day course desgined for programmers, software analysts and software engineers. Defines goals and principles of Ada and software engineering	1861 Wiehle Avenue	Reston	Virginia	22090	Willie Griffin	703-478-2032
78	Honeywell Federal Systems, Inc.	Ada for Mangers - 1 day course to introduce non-technical mangers of the ocncepts and issues involved in the administration of Ada projects.	1861 Wiehle Avenue	Reston	Virginia	22090	Willie Griffin	703-478-2032
79	Honeywell Federal Systems, Inc.	Ada for Project Mangers - 5 day course to develop skills for managing an Ada project.	1861 Wiehle Avenue	Reston	Virginia	22090	Willie Griffin	703-478-2032
80	Honeywell Federal Systems, Inc.	Ada Programming - 10 day course desgined to teach programmers experienced in a high-level language	1861 Wiehle Avenue	Reston	Virginia	22090	Willie Griffin	703-478-2032
81	Honeywell Federal Systems, Inc.	Ada Programming Concepts - 5 day course that introduces goals and principles of software engineering. Introduces Ada syntax, data typing and the Ada reference manual	1861 Wiehle Avenue	Reston	Virginia	22090	Willie Griffin	703-478-2032

Commerically Available Ada Courses

8 2	Honeywell Federal Systems, Inc.	Ada Programming Tools - 5 day course designed for systems managers and engineers involved in the development of an Ada system.	1861 Wiehle Avenue	Reston	Virginia	22090	Willie Griffin	703-478-2032
8 3	Honeywell Federal Systems, Inc.	Ada Software Applied Design - 5 day course discussing aspects of object-oriented design as it relates to software life cycles.	1861 Wiehle Avenue	Reston	Virginia	22090	Willie Griffin	703-478-2032
8 4	Honeywell Federal Systems, Inc.	Advanced Ada Programming - 10 day course designed to teach programmers experienced in Ada how to code I/O statements and develop code with exception handlers, tasks and generics	1861 Wiehle Avenue	Reston	Virginia	22090	Willie Griffin	703-478-2032
8 5	Honeywell Federal Systems, Inc.	Advanced Ada Programming - 15 day course where attend designs, encodes and tests complete programs.	1861 Wiehle Avenue	Reston	Virginia	22090	Willie Griffin	703-478-2032

Ada Education and Training

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
1	Auburn University	Advanced Programming in Ada	Comp Sci and Eng Dept 111 Dunstan Hall	Auburn	Alabama	36849	Dr. Thomas Phillips	205-826-4330
2	Birmingham-Southern College	1-Alternative Languages 2-The Ada Programming Lang.	Div. of Science and Math 800 8th Ave West	Birmingham	Alabama	35254	Richard Turner	205-226-4870
3	Univ. of Alabama at Birmingham	Formal Specifications and Software Development	Sch of Natural Sci Dept of Comp & Info Sciences	Birmingham	Alabama	35294	Dr. Warren Jones	205-934-2213
4	University of Ala/Huntsville	Software Development and Design Using Ada	CSC Department	Huntsville	Alabama	35899	Warren Mosely	205-895-6088
5	University of Southern Alabama	Programming Lang: Ada	Div of Computer & Information Science	Mobile	Alabama	36688	Marino Niccolai	205-460-6390
6	Alabama A&M	Structured Programming with Advanced Languages: Ada	Dept of Computer & Info Sciences P.O. Box 88	Normal	Alabama	35762	Dr. Hrishikesh Saha	205-859-7339
7	University of Alabama	Ada and Concurrent Programming	Dept. of Comp Sci	University	Alabama	35487	Dr. Wen-Kai Chung	205-348-6363
8	University of Alaska	Computer Programming II (includes Ada as a second language)	Dept of Math & Computer Science Chapman Building	Fairbanks	Alaska	99775	Barbara Lando	907-474-7332
9	University of Alaska Southeast	Ada for Programmers	School of Bus & PA 1108 F. Street	Juenau	Alaska	99801	Timothy J. Fullam	907-789-4402
10	North Arizona State	Courses for sophomores and juniors			Arizona			
11	University of Arizona				Arizona			

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
12	Arizona State University	Introduction to Ada	Computer Science Department	Tempe	Arizona	85287	Dr. Terry Mellon	501-965-2774
13	Azusa Pacific University	Structured Programming 2 - Ada	Computer Science Department P.O. Box APU	Azusa	California	91702	Wendell Scarborough	818-969-3434
14	CSU/Dominguez Hills	High Level Languages: Ada	1000 E. Victoria St Building NSM A132	Carson	California	90747	Dr. R. Huddleston	213-224-3287
15	CA State University	Advanced Software Practices	Department of Computer Science	Chico	California	9592041	Paul Luker	916-895-6442
16	Harvey Mudd School	1-Programming Languages 2-Introduction to Programming	Dept. of Computer Science	Claremont	California	91711	Dr. Michael Erlinger	714-621-8225
17	University of CA at Irvine	Ada	Information & Comp Science Dept	Irvine	California	92717	Dr. Dennis Volper	714-856-7403
18	CA State Univ/Long Beach	Software Engineering with Ada	Comp Sci & Eng Dept 1250 Bellflower Blvd.	Long Beach	California	90840	Joel Carissimo	213-498-4285
19	California State Univ/LA	Ada Programming	Dept of Math & Comp Science 5151 State Univ Dr	Los Angeles	California	90032	Mr. Fraser	213-224-3287
20	CA State Univ/Northridge	Software Engineering with Ada	Dept. of Computer Science, School of Engineering	Northridge	California	91320	Shawn Barkataki	818-885-3398
21	Merritt College	Software Engineering with Ada		Oakland	California		Dr. Richard D. Riehle	415-858-1551
22	CA State Polytechnic Univ/Pamona	1-Ada 2- Software Engineering	Department of Computer Science	Pamona	California	91788	Dr. Kenneth McDonald	714-869-3440

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
23	National University	1-Princ of SW Engineering 2-Intro to Appl Prog Lang-Ada 3-Adv. Appl Programming 4-Advanced Software Engin 5- Data Base Mgt. 6-Princ of H/W & SW Integr 7-Expert Systems 8-V & V Techniques	School of Engineering and Computer Sciences Master of Science	San Diego	California	92108	Prof. Peter Sibley	619-563-7123
24	National University	6-Princ of H/W & SW Integr 7-Expert Systems 8-V & V Techniques		San Diego	California	92108	Prof. Peter Sibley	619-563-7123
25	National University	9-Software Eng. Project I 10-Software Eng. Project II 11-Software Eng. Project III		San Diego	California	92108	Prof. Peter Sibley	619-563-7123
26	National University	Software Engineering Master's Program where students are required to know Ada -two month Ada course		San Diego	California		Richard Ridhile	415-858-1551
27	San Diego State			San Diego	California			
28	San Jose State University	Software Engineering with Ada	Dept. of Math & Computer Science	San Jose	California	95192	Evelyn E. Obaid	408-924-5139
29	Univ. of California/ Santa Barbara	Programming Languages	Computer Science Department	Santa Barbara	California	93106	Laura Dillon	805-961-3411
30	Stanford University	Object-Oriented Design with Ada	School of Eng. Dept. of Comp Sci	Stanford	California	94305	Proj Stuart Reges	415-723-9798
31	California Lutheran University	CS 212A: Ada Programming	60 West Olsen Road	Thousand Okas	California	91360	Roy James Guild	805-493-3362
32	Pikes Peak Community College	Introduction to Ada Programming	3675 S. Academy Blvd.	Colorado Springs	Colorado	80906	Vivian M. Challen	303-576-7711
33	University of Colorado at Colorado Springs	Introduction to Software Engineering	Sch of Eng & Appl Science Dept of Comp Sci	Colorado Springs	Colorado	80933	Dr. Robert Sebesta	303-593-3325

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
34	University of Colorado at Denver	Parallel Computing with Ada	Math Department University Box 170 1200 Larimer St.	Denver	Colorado	80204	Dr. Zenas Hartvigson	303-556-8442
35	University of S. Colorado	1-Ada and Software Eng II 2-Software Engineering with Ada	Computer Science Department 2200 N. Bonforte	Pueblo	Colorado	81001	Robert Cook	303-549-2752
36	Colorado State University				Colordao			
37	University of Connecticut	Graduate level courses	Computer Science Department		Connecticut			
38	Central Connecticut State U	Advanced Topics in Computer Science: Ada	Department of Math & Comp Sci 1615 Stanley St	New Britain	Connecticut	6050	A. Zoe Leibowitz	203-827-7568
39	Central State University	Advanced Topics in Computer Science: Ada	1615 Stanley Street	New Britain	Connecticut	6050	A. Zoe Leibowitz	203-827-7568
40	Southern Connecticut State Univ	1-Ada Programming 2-Organization of Programming Languages	Computer Science 501 Crescent Street	New Haven	Connecticut	6515	Dr. JoAnn Parikh	203-397-4514
41	University of New Haven	Programming in Ada	Depart of Industrial Eng & Computer Science	West Haven	Connecticut	6516	Gary Walters	203-932-7067
42	University of Connecticut	Graduate Level courses			Connecticut			
43	American University	Data Structures	Dept of Comp Sci and Information Sciences	Washington	D.C.	20016	Richard A. Holzsager	202-885-1470
44	Gallaudet University	Data Structures using Ada	Dept of Math/Computer Science	Washington	D.C.	20002	Howard L. Egan	202-651-5315

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
45	Howard University	1-Advanced Prog. Languages 2-Real-Time Systems	Systems & Computer Science School of Eng.	Washington	D.C.	20059	Don Coleman	202-636-6595
46	University of Florida	Upper level courses			Florida			
47	University of Southern Florida	Introduced in Sophomore and Junior level courses			Florida			
48	Florida Atlantic University	Software Engineering	Department of Computer Science	Boca Raton	Florida	33431	Dr. Neal Doulier	305-393-3180
49	Manatee Community College	Introduction to Ada	5840 26th Street West	Bradenton	Florida	34207	Dr. Donald P. Purdy	813-755-1511
50	St. Peter's Jr College	Ada Programming	2465 Drew St.	Clearwater	Florida	34615	Jim Hill	813-791-2530
51	Brevard Community College	1-Intro to Ada Programming 2-Advanced Ada	Business Division 1519 Clear Lake Rd	Coco	Florida	32926	Dennis Koile	305-632-1111
52	Embry-Riddle Aeronautical University	Intro to Software Engineering	Computer Science ERAU (PD-AAC)	Daytona Beach	Florida	32014	Dr. Jagdish Agrawal	904-239-5590
53	Florida Institute of Technology	Ada and its Programming Environment	150 University Ave. Dept of Comp Sci	Melbourne	Florida	32901	Luwana Clever	305-768-8091
54	University of Miami	Software Development with Ada	Elec & Comp Eng P.O. Box 248294	Miami	Florida		Susan D. Urban	305-284-3452
55	Univ. of Central Florida	1-Software Engineering I 2-Software Engineering II	Dept of Computer Eng CEBA 207	Orlando	Florida	32816	Dr. Darrell Linto	305-275-2236

Universities Teaching Ada

Univerlsity	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
56 Florida State University	1-Real-Time Programming 2-Software Engineering with Ada	Compu Sci Dept Room 206 Love Building	Tallahassee	Florida	32306	Greg Riccardi/Ted Baker	904-644-2296
57 Univ of Georgia	Software Engineering	Dept of Com Sci 415 Boyd Graduate Studies Center	Athens	Georgia	30602	Dr. Orville Weyrich	404-542-2911
58 Atlanta Univ	1-Design and Programming Languages 2-Software Engineering	Dep Math & Com Sci James Brawley Dr., SW	Atlanta	Georgia	30314	Steven Ornburn	404-681-0251
59 Georgia Institute of Technology	Abstraction and Specification in Program Development	School of Info/malton/Comp Sci	Atlanta	Georgia	30332	Richard LeBlanc	404-894-2592
60 Georgia State University	Software Engineering	Dept. of Math & Compu Sci	Atlanta	Georgia	30303	Dr. Scott Owen	404-651-2253
61 Morehouse College	Introduction to Ada	Dept of Comp Sci P.O. Box 137	Atlanta	Georgia	30314	William McGuiver	404-525-1501
62 La Grange College	Introduction to Object Oriented Design	Computer Science Department 601 Broad Street	LaGrange	Georgia	30240	Tony Valle	404-882-2911
63 Armstrong State Univ	Comparative Languages	Dept of Comp Sci Dept of Math & Comp Sci	Savannah	Georgia	31419	Dr. Sigmund Hudson	912-927-5317
64 Chaminade University	Special Topics: Ada	Computer Science Department 3140 Waiwai	Honolulu	Hawaii	96816	Ward Hayward	808-735-4805
65 Leeward Community College	The Programming Language	96 045 Ala Ike	Pearl City	Hawaii	96782	LeRoy C. Johnson	808-455-0273
66 Parks College of St. Louis Univ.	Software Engineering with Ada	Computer Science Department	Calhoun	Illinois	62206	Dr. C.C. Kirkpatrick	618-337-7500

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
67	DePaul University	1-Programming in Ada 2-Software Engineering	Comp Sci & Info Sy 243 S. Wabash	Chicago	Illinois	60604	George Knall	312-341-8381
68	Illinois Institute of Technology	1-Software Eng. With Ada 2-Concurrent Programming	Dept of Comp Sci SP Building, IIT Central	Chicago	Illinois	60616	Fred Maymir	312-567-5142
69	Southern Illinois Univ at Edwardsville	1-Programming Lang Concepts 2-Topics in S/W Eng Using Ada	Department of Computer Science	Edwardsville	Illinois	62026	Dr. Hattemer	618-692-2386
70	Elmhurst College	Software Engineering	Dept of Math & Comp Sci 190 Prospect Ave	Elmhurst	Illinois	60126	John Jeffrey	312-279-4100
71	McKendree College	1-Ada Programming I 2-Ada Programming II 3- Ada Programming III 4-Ada Programming IV	Computer Science Department 701 College Road	Lebanon	Illinois	62254	Capt. Roy Rogge	618-537-4481
72	Western Illinois University	The Language Ada	Department of Computer Science	Macomb	Illinois	61455	Dr. David Ballew	309-298-1452
73	University of Evansville	Ada Programming	Dept of Compu Sci 1800 Lincoln Ave	Evansville	Indiana	47722	Mr. Bruce Mavis	812-479-2652
74	Indiana Univ-Purdue Univ/Fort Wayne	1-Data and File Structures 2-Object-Oriented System Development	Comp Tech Dept. 2101 Coliseum Blvd. E.	Fort Wayne	Indiana		Karl Rehmer Mark Temte	219-481-6176 219-481-6803
75	Ball State University	Principles of Software Engineering	Dept. of Comp Sci Program in Comp Sci	Muncie	Indiana	47306	Prof. W.F. Brown	317-285-8644
76	Notre Dame		Computer Science Department	South Bend	Indiana			
77	Indiana State Univ at Terre Haute	Ada for Systems Programming	Math & Comp Sci Holmstedt Hall	Terre Haute	Indiana	47809	Dr. Guy Hale	812-237-2130

Universities Teaching Ada

	Univerlsity	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
78	Rose-Hulman Institute of Technology	Introduction to Ada	5500 Walbash Ave	Terre Haute	Indiana	47803	Cary Laxer	812-877-1511
79	Iowa State University	Software Engineering	Dept of Computer Science	Ames	Iowa	50011	Albert L. Baker	515-294-4377
80	Simpson College	Introduction to Programming Ada	Dept. of Comp Sci 701 N. C Street	Indianola	Iowa	50125	Richard A. Bee Be	515-961-1586
81	University of Iowa	Programming Language Concepts	Dept. of Computer Science	Iowa City	Iowa	52242	Raymond Ford	319-335-0707
82	Cornell University	Programming Language Concepts	Dept. of Computer Science	Mt. Vernon	Iowa	52314	Tony DeLaubenfels	319-895-8811
83	Kansas State	Graduate Level courses	Computer Science Department		Kansas			
84	Hutchinson Community College	Ada Language Programming	1300 North Plum Street	Hutchinson	Kansas	67501	John Morrell	316-665-3500
85	St. Mary College	1-General Programming I 2-General Programming II	Comp Sci Dept 4100 South 4th Street	Leavenworth	Kansas	66048	Victor Meyer	913-682-5151 x319
86	Wichita State University	1-Ada 2-Ada & Software Engineering 3-Intro to Software Eng. 4-S/W Testing & Reliability	Comp Sci Dept Box 83	Wichita	Kansas	67208	Mark Rutter James E. Tomayko	316-689-3156 316-689-3155
87	Western Kentucky Univ	Ada Programming	Dept of Computer Science	Bowling Green	Kentucky	42101	Dr. Crenshaw	502-745-4642
88	Northern Kentucky Univ	Programming Lanugages	Dept of Math and Computer Science	Highland Heights	Kentucky	41076	Don Galli	606-572-5320

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
89	University of Kentucky	Programming Languages	Dept of Comp Sci 915 Patterson Office Tower	Lexington	Kentucky	40506	Prof. Harris	606-257-3961
90	Eastern Kentucky Univ	Advanced Programming Techniques with Ada	Dept of Statistics/Comp Science Wallace 402 119 Stevens Memorial Hall	Richmond	Kentucky	40475	Don Greenwell	606-622-5942
91	University of South Western Louisiana	1-Ada Programming II 2-Programming in Ada/Intro to Software Engineering		Lafayette	Louisiana	70503	Jagadeesh Namdigan	318-231-5647
92	Louisiana Tech University	1-Software Methodology 2-System Design	Department of Computer Science	Ruston	Louisiana	71272	Prof. Margaret Schaar	318-257-2298
93	University of New Orleans			New Orleans	Louisiana			
94	University of Maine/Orono	Software Engineering	Comp Sci Dept 222 Neville Hall	Orono	Maine	4469	Dr. Larry Latour	207-581-3941
95	Johns Hopkins University	Software Engineering with Ada	Cont. Prof. Programs-GWC Whiting School of Eng.-Merryman Hall	Baltimore	Maryland	21218	Mr. Gralia	301-338-8728
96	Univ. of Maryland at College Park	1-Programming in Ada 2-Software Design & Dev 3-Software Development in Ada	Dept of Comp Sci	College Park	Maryland	20742	Dr. Rombach	301-454-2002
97	University of Maryland	1-Introduction to Ada 2-Applying Adv Features in Ada 3-Concepts in Ada	University College	College Park	Maryland	20742	Duane Jarc Helmuth Theiss	301-985-7000 301-985-70
98	Capital University	Ada Programming	Computer Science	Laurel	Maryland		Jack Bieler	703-941-8888 301-596-0161
99	Univ. of Maryland/ Eastern Shore	Topics in Programming Languages: Ada	Dept of Math and Computer Science	Princess Anne	Maryland	21853	Edward Chapin	301-651-2200

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
100	Towson State University	Software Engineering Using Ada	Dept. of Computer and Information Sciences	Towson	Maryland	21204	Mr. Helmut Theiss	301-321-2633
101	Univ of Mass/Amherst	Software Engineering	Dept of Computer and Information Sciences	Amherst	Massachusetts	01003	Eliot Moss	413-545-2744
102	Boston University	1- System Design 2- Embedded Computer Software Design 3-Introduction to Ada	College of Eng. 110 Cummington S	Boston	Massachusetts	02215	Dr. Richard Vidale	617-353-2808
103	Southeast Mass University	1-Software System Design with Ada 2-Process Based Design	Computer Science Department	N. Dartmouth	Massachusetts	02747	Jan Bergandy	617-999-8293
104	North Adams State College	1-Advanced Programming Langs 2-Systems Software Design 3-Comparative Prog Languages	Dept of Computer Science	North Adams	Massachusetts	01247	Ernie Giangrande Beverly Smith	413-664-4511
105	Western New England College	1-Data Structures 2-Organization of Programming Languages	Dept of Math and Computer Science	Springfield	Massachusetts	01119	Prof. L.S. Tang Prof. Lloyd Emerson	413-782-3111
106	University of Michigan	Ada Based Software Engineering	Computer Science 3314 EACS Building	Ann Arbor	Michigan	48109-2122	Dr. Richard Volz	313-763-0035
107	Michigan State	Ada: An Introduction	2244 Lansing Avenue	Detroit	Michigan	44657	Malcolm Davis	800-778-9009
108	Western Michigan University	Programming Languages	Dpet. of Computer Science	Kalamazoo	Michigan	49008	Dr. Kenneth Williams	616-383-6151
109	Central Michigan University	Alternative Programming Languages	Dept of Comp Sci Pearce Hall	Mt. Pleasant	Michigan	48859	Cindy Burt	517-774-3774
110	Oakland University	Short Course in Ada Programming	Dept of Comp Sci & Eng. Dodge Hall of Eng.	Rochester	Michigan	48063	Dr. Frank Cloch	313-370-2200

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
111	Saginaw University	Software Design and Development	Science 357 2250 Pierce Road	University Center	Michigan	48710	Katherine Kerr	
112	Eastern Michigan University	Software Engineering	Comp Sci Dept 620 Pray-Harold Bldg	Ypsilante	Michigan	48197	Dr. William McMillan	313-487-1063
113	University of Minnesota	1-Software Engineering I 2-Software Engineering II 3-Software Engineering III 4-Software Eng with Ada Introduction to Ada	Dept of Computer Science	Minneapolis	Minnesota	55455	Dr. Wei-Tak-Sai	612-625-4002
114	Winona State University		Department of Computer Science	Winona	Minnesota	55987	Mr. Daryl Henderson	507-457-5385
115	Mississippi State University	Courses offered at the Junior and Senior level			Mississippi			
116	Mississippi Valley State				Mississippi			
117	Univ. of Southern Mississippi	1-Operating Systems & Computer Architecture II 2-Software Engineering II	Dept of Comp Sci Box 5106 Southern Station	Hattiesburg	Mississippi	39406	Cliff Burgess Ralph Bisland, Jr.	601-266-4958 601-266-4949
118	Univ. of Mississippi at Oxford	1-Software Engineering Using Ada 2-Programming in Ada	Comp & Info Sci Farley Hall, Room 331	University	Mississippi	38677	Pam Lawhead	601-232-7396
119	Southeast Missouri State University	Ada Programming	Compu Sci Dept	Cape Girardeau	Missouri	63701	Michael Britt	314-651-2525
120	University of Missouri at Columbia	Programming Languages	Dept of Comp Sci Mathematical Science Building	Columbia	Missouri	65211	William Slough	314-882-3842
121	Northwest Missouri State University	Specialized Languages: Ada	Compu Sci Dept	Maryville	Missouri	64468	Richard Detmer	816-562-1187

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
122	University of Missouri - Rolla	Introduction to Ada	Computer Science Department	Rolla	Missouri			
123	St. Louis Community College Meramec	Ada Programming	11333 Big Bend	St. Louis	Missouri	63122	Robert L. Monsees	314-966-7526
124	Washington University	1-Prog Systems and Language 2-Software Eng Workshop 3-Modular Programming	Sever Inst of Tech Dept of Comp Sci	St. Louis	Missouri	63130	Dr. Gruija-Catalin Roman	314-889-6190
125	New Jersey Institute of Technology				New Jersey			
126	Jersey City State College	1-Introductory Ada 2-Software Engineering	Ada Tech Center 2039 Kennedy Blvd	Jersey City	New Jersey	07305	Phillip Caverly	201-547-3291
127	Stockton State College			Stockton	New Jersey			
128	Fairleigh Dickinson University	1-Advanced Programming Language Constructs Using Ada 2-Concepts of Prog Languages 3-Prog Language Concepts	Dept of Comp Sci 1000 River Road	Teaneck	New Jersey	07666	Gertrude Neuman Levine	201-692-2020/ 2261
129	Montclair State College	1-Programming Languages 2-Programming Languages Design Software Engineering With Ada	Dept of Math/Computer Science	Upper Montclair	New Jersey	07043	Carl Bredlau	201-893-4263
130	Univ. of New Mexico/Albuquerque		Computer Science Department	Albuquerque	New Mexico	87131	Chaires Crowley	505-277-3112
131	New Mexico State University	Software Development	Department of Computer Science Prog in Comp Sci	Las Cruces	New Mexico	88003	Prof. Dan Dearholt	505-646-3724
132	New Mexico University/Las Cruces	Ada Programming	Dept of Comp Sci Box 3CU	Las Cruces	New Mexico	88003	Don Dearholt	505-646-3723

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
133	University of New Mexico/Los Alamos	Intro to Software Engineering	Department of Computer Science	Los Alamos	New Mexico	87544	Ms Angela Coop	505-662-5919
134	RPI	Graduate Level courses			New York			
135	State University of New York/Binghamton	1-Software Engineering I 2-Software Engineering II	Thomas J. Watson School of Eng, Applie Sci & Tech Dept of Comp Sci	Binghamton	New York	13901	Proj Thomas Piatkowski	607-777-4802
136	Long Island Univ/CW Post Campus	1-Embedded and Scientific Systems Using Ada 2-Software Engineering with Ada	Computer Science Department	Brookville	New York	11548	Ms. Susan Dorchak	516-299-2293
137	Canisius College	Programming Languages	Dept. of Comp Sci 2001 Main Street	Buffalo	New York	14208	Dr. Patricia Van Verth	716-883-7000
138	State University of New York/Fredonia	1-Introduction to Ada 2-Ada: A Seminar for Faculty	Dept of Math and Computer Science	Fredonia	New York	14063	Dr. Joseph Straight	716-673-3459
139	Hofstra University	Ada for PL/I, Pascal or Fortran Users Advanced Programming Techniques for Business App	Dept of Comp Sci Business Computer Info Systems	Hempstead	New York	11550	Dr. Phillip J. Pnzeca Dr. Vasiliscu	516-560-5555 516-560-5716
140	Niagra University	1-Programming Languages 2-Topics in Computer Science	Department of Computer and Information Sciences	Niagra University	New York	14109	Dr. Hubbard	716-285-1212
141	State University of New York/Potsdam	Selected Language of Ada	Department of Computer Science	Potsdam	New York	13676	David Rokh	315-267-2073
142	Rochester Institute of Technology	Algorithms and Data Structures	Graduate Computer Science Dept. One Lomb Memorial Drive	Rochester	New York	14623-0887	Dr. Peter Anderson	716-475-2529
143	Le Moyne College	1-Software Eng Project 2-Intro-Program Methodology 3-Data Structures & Program Development		Syracuse	New York	13214	James F. Smith	315-445-4544

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
144	Syracuse University	Graduate level courses		Syracuse	New York	13214		
145	University of North Carolina	Undergraduate level course	Computer Science Department	Charlotte	North Carolina			
146	East Carolina University	Organization of Programming Language		Greenville	North Carolina	27834	Dr. Masao Kishore	
147	North Carolina State University	Software Engineering with Ada	Dept of Comp Sci Prog in Comp Sci	Raleigh	North Carolina	27695	Prof. K.C. Tai	919-737-7862
148	North Dakota State University	New Developments in Programming Languages	Box 5075	Fargo	North Dakota	58105	Ken Magel	701-237-8189
149	North Dakota State University	New Developments in Programming Languages	Box 5075	Fargo	North Dakota	58105	Ken Magel	701-237-8189
150	University of North Dakota	1-Ada 2-Software Eng. with Ada	Department of Computer Science	Grand Forks	North Dakota	58202	Randy Molmen Dr. Lonny Winrich	701-777-4107
151	Ohio State	Advanced courses in Ada			Ohio			
152	Ohio Northern University	Software Engineering	Department of Math/Ada and Computer Science	Ada	Ohio	45810	David A. Retterer	419-772-2346
153	Univ. of Cincinnati	Special Topics: Programming in Ada	Department of Computer Science	Cincinnati	Ohio	45221-0008	Dieter Schmidt	513-475-6964
154	Cleveland State University	Development of Large Programming Systems	Comp Sci Dept Euclid At 24th St.	Cleveland	Ohio	44115	Paul Jalick	216-687-4760

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
155	Franklin University	Organization of Programming Languages	Department of Computer Science 201 S. Grand Ave.	Columbus	Ohio	43215	Bob Vermilyer	614-224-6237
156	University of Dayton	1-Algorithms & Programming II 2-Data Structures	300 College Park CMSC Department	Dayton	Ohio	45469	Joseph Lang	513-229-3831 513-229-2192
157	Kent State University	1-Ada Programming 2-Advanced Ada	Dept of Mathematical Sciences	Kent	Ohio	44242-0001	Keith Yerian	216-672-2209
158	Marietta College	Data Structures in Algorithm Analysis	Computer Science Department	Marietta	Ohio	45750	E. Robert Anderson	614-374-4600
159	Miami University of Ohio	The Ada Programming Language	Systems Analysis Department Kreger Hall	Oxford	Ohio	45056	Jim Kiper	513-529-1252
160	University of Toledo	1-Survey of High Level Programming Languages 2-Concurrent Programming	Dept of Computer Science and Engineering	Toledo	Ohio	43606	Dr. Hilda Standley	419-537-2303
161	Oklahoma State University				Oklahoma			
162	Central State University	1-Programming in Ada 2-Computer Networks	Dept of Comp Sci 100 N. University	Edmond	Oklahoma	73034	Bill McDaniel	405-341-2980
163	Cameron University	Intermediate Programming with Ada	Dept of Math Sciences West Gore	Lawton	Oklahoma	73505	Feridoon Moinian	405-581-2481
164	Oklahoma State University	Ada Programming Language	Department of Computing & Information Sciences, MS-219	Stillwater	Oklahoma	74078	Dr. K.M. George	405-624-5668
165	Oral Roberts University	Special Topics: Software Engineering	Dept of Math/Comp Science 7777 S. Lewis	Tulsa	Oklahoma	74171	Jeffrey Jackson	918-495-6701

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
166	University of Tulsa	Comparative Programming Languages	Dept of Math & Comp Sci 600 South College	Tulsa	Oklahoma	74104	Travis Tull	918-542-6000 x2228
167	Lebanon Valley College	Programming in Ada	Dept of Math Science	Anncville	Pennsylvania	17003	Mike Fry	717-867-6188
168	Widener University	Programming Languages	Dept of Comp Sci Science Division	Chester	Pennsylvania	19013	Dr. Norman Adams	215-499-4002
169	Cheyney University of PA	Software Engineering Using Ada	Dept of Mathematics and Computer Science	Cheyney	Pennsylvania	19319	Jesse Williams	215-399-2435
170	Elizabethtown College	Comparison of Programming Languages	Department of Computer Science 1 Alpha Drive	Elizabethtown	Pennsylvania	17022	Ms. Barbara Tulley	717-367-1151
171	Beaver College	Modern Programming Languages: Ada	Dept of Computer Science & Mathematics	Glenside	Pennsylvania	19038	Mark Balcer	215-572-2984
172	Gwynedd-Mercy College	1-Ada 2-Software Engineering Using Ada	Comp Sci Dept Sunneytown Pike	Gwynedd Valley	Pennsylvania	19437	Michael G. Gonzales	215-641-5547
173	Carnegie Mellon	Software Engineering	Department of Computer Science	Pittsburgh	Pennsylvania	15213	Dr. Nico Habermann	412-268-2592
174	University of Pittsburgh	Programming Languages	Dept of Comp Sci Alumni Hall	Pittsburgh	Pennsylvania	15260	Dr. George Novack	412-624-8490
175	University of Scranton	Programming Languages	Computer Science Department	Scranton	Pennsylvania	18510	Dennis Martin	717-961-6115
176	Slippery Rock University	Ada	Dept of Comp Sci Slippery Rock U	Slippery Rock	Pennsylvania	16057	Richard Hunkler	412-794-7133

Universities Teaching Ada

	Univerlality	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
177	Penn State University	Software Design Methods	220 Whitmore Lab	University Park	Pennsylvania	16802	Fred L. Bierly	814-863-1241
178	Villanova University	1-The Linguistics of Programming Languages 2-Organization of Programming Languages	Computer Science Program	Villanova	Pennsylvania	19085	Robert Beck Lillian Cassell	215-645-7307
179	Univ of Rhode Island	Software Engineering	Dept of Compu Sci and Statistics Tyler Hall	Kingston	Rhode Island	02881	Jan Prichard	401-792-2701
180	Clemson University	Programming Systems	Dept of Electrical/Computer Engineering	Clemson	South Carolina	29634	Dr. James Leathrum	803-656-5930
181	Tennessee State University				Tennessee			
182	Tennessee Technical University	Advanced Programming - Ada	Comp Sci Dept Box 5101	Cookeville	Tennessee	38505	Donald C. Ramsey	615-372-3691
183	East Tenn State Univ	1-Advanced Prog Techniques 2-Software Engineering 3-Systems Design	Comp Sci Dept Box 23830A	Johnson City	Tennessee	37614-0002	Suzanne Smith	615-929-6963
184	State Technical Institute at Knoxville	Ada	Hardin Valley Road Box 22990 ATTN: CST Dept	Knoxville	Tennessee	37933	Gerald Wlaker	615-694-6468
185	Memphis State University	1-Ada Programming 2-Operating Systems	Department of Mathematical Sciences	Memphis	Tennessee	38152	David Vaught	901-454-2482
186	Middle Tennessee State University	Programming Languages	Comp Info Systems Box 50	Murfreesboro	Tennessee	37132	Dr. Nathan Adams	615-898-2362
187	Vanderbilt University	Software Engineering	School of Eng. Dept of Comp Sci	Nashville	Tennessee	37235	Dr. Stephen R. Schach	615-322-2924

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
188	SW Texas State	One undergraduate course and one advanced course			Texas			
189	McMurry College	Ada Programming with Applications	Computer Science Department	Abilene	Texas	79697	Louis Voit	915-691-6393
190	Univ. of Texas at Arlington	1-Introduction to Software Engineering with Ada 2-Adv. Software Engineering 3-Software Engineering in Ada	Comp Sci Eng Dept P.O. Box 19015	Arlington	Texas	76019	Dr. Paul C. Grabow	817-273-2348
191	University of Texas	Software Engineering	Department of Computer Science	Austin	Texas	78712	Laurie H. Werth	512-471-9535
192	Texas A&M	400 Level Courses	Computer Science Department	College Station	Texas			
193	East Texas State University	Survey of Programming Languages	Computer Science Department	Commerce	Texas	75428	Sandra Huerter	214-886-5409
194	University of North Texas	Introduction to Software Engineering	Dept of Comp Sci P.O. Box 13886	Denton	Texas	76203	Dr. Jeff Harris	817-565-2801
195	Texas Christian University	1-Ada Software Development and Programming 2-Ada Design and Development	Comp Sci Dept P.O. Box 32886	Fort Worth	Texas	76129	Ted Tenny Tom Nute	817-921-7166
196	University of Houston/Clear Lak	1-Ada Programming Lang 2-Software Design 3-Dev of Software Tools 4-Seminars in Software Eng.	Department of Computer Science	Houston	Texas	77058	Theodore Liebfried Dr. Charles McKay Dr. Anthony Lakkos Dr. Charles McKay	713-488-9480
197	Sam Houston State University	1-Ada 2-Ada: Object-Oriented Programming	P.O. Box 2206	Huntsville	Texas	77341	Dr. Burris Wuhsung Lu	409-294-1568 409-294-1837
198	Texas Technical University	Structured Programming and Software Engineering	Dept of Comp Sci Mail Stop 3102	Lubbock	Texas	79409	Dr. James Archer	806-742-3527

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
199	Stephen F. Austin State University	Software Development Applications	Sch of Bus Admin Dept of Comp Sci	Nacogdoches	Texas	75962	Dr. Jarrell Grout	409-568-1876
200	Prairie View A&M	1-Introduction to Ada 2-Advanced Ada	Department of Computer Science	Prairie View	Texas	77446	N. Ravindran	409-857-2715
201	Southwest Texas State University	Advanced Software Engineering	School of Science Dept. of Comp Sci	San Marcos	Texas	78666	Dr. C.J. Hwang	512-245-3409
202	Utah State University	Software Development/Implementation	College of Science Dept. of Comp Sci	Logan	Utah	84322-4205	Prof. Greg Jones	801-750-3267
203	Weber State College	Emerging Techniques in Computing	Computer Science Department	Ogden	Utah	84408-2401	David Hart	801-626-7093
204	Utah Valley Community College	Ada: A First Language	800 West 1200 South	Orem	Utah	84057	Dr. Harrington	801-226-5000
205	Brigham Young University	Introduction to Software Design	Dept of Computer Science	Provo	Utah	84602	Prof. Scott Woodfield	801-378-2915
206	Vermont Technical College	1-Introduction Ada Programming 2-Advanced Ada Programming	Electrical & Electronic Eng. Technology Dept.	Randolph Center	Vermont	05061	Dr. Carl Brandon	802-728-3391
207	University of Virginia	Software Engineering	Department of Computer Science	Charlottesville	Virginia	22903	Prof. Robert Cook	804-924-7605
208	George Mason University	Real-Time Systems Design and Development	School of Info Tech and Engineering 4400 University Dr	Fairfax	Virginia	22030	Dr. Jorge Diaz-Herrera	703-323-2713
209	Hampton University	1-Introduction to Ada 2-Advanced Ada Programming	Department of Computer Science	Hampton	Virginia	23668	Robert A. Willis	804-727-5552

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
210	Christopher Newport College	Ada Programming Language	Dept of Comp Sci 50 Shoe Lane	Newport News	Virginia	23606	Prof. Tean-Quay Lee	804-599-7065
211	Norfolk State University	1-Ada Programming I 2-Ada Programming II	Dept of Math & Computer Science 2401 Corprew Ave	Norfolk	Virginia	23504	George C. Harrison	804-623-8654
212	Old Dominion University	Ada Programming	Department of Computer Science	Norfolk	Virginia	23508	Hill Price	804-440-3915
213	University of Washington	Both graduate and undergraduate courses	Computer Science Department		Washington			
214	Eastern Washington University	Advanced Programming in Ada	Computer Science Department	Cheney	Washington	99004	Dr. Ray Hamel	509-458-6260
215	Gonzaga University	Programming Languages	Dept Math & and Computer Science 509 E. Boone	Spokane	Washington	99258	Brian Carlson	509-328-4220
216	George Washington University	Graduate level: 1-Design of Translators 2-Comparative Prog Languages 3- Concurrency & Parallelism	Computer Science Department		Washington, D.C.		Michael Feldman	202-994-5253
217	George Washington University	Undergraduate level: 1-Operating Systems 2-Programming & Data Struc 3-Theory of Comp Translators	Computer Science Department		Washington, D.C.		Shmuel Rotenstreich Michael Feldman	202-994-5252 202-994-5253
218	Beckley College	Introduction to Ada Programming	Dept of Comp Sci P.O. Box AG	Beckley	West Virginia	25802	Stephanie Ketz	304-253-7351 ext. 14
219	West Virginia Wesleyan College	Ada Programming	Dept of Math & Computer Science	Buckhannon	West Virginia	26201	Ron Klauswitz	304-473-8000
220	Marshall University	Software Engineering with Ada	Dept of Computer & Information Sciences	Huntington	West Virginia	25701	Kathleen Warner	304-696-5424

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
221	West Virginia College of Graduate Studies	1-Software Engineering with Ada 2-Introduction to Ada Programming	Eng. & Science Div Information Systems	Institute	West Virginia	25112	Robert N. Hutton	304-768-9711
222	West Virginia Institute of Technology	Special Topics - Ada Programming	Department of Computer Science	Montgomery	West Virginia	25136	Don Smith	304-442-3361
223	West Virginia University	1-Ada & Object-Oriented Design 2-AI Applications of Ada 3-Introduction to Computing 4-Software Engineering	Dept of Stats & Comp Sci Knapp Hall	Morgantown	West Virginia	26506	Dr. Frances VanScoy	304-293-3607
224	Alderson Braddice College	1-Computer Language: Ada 2-Software Engineering	Div of Natural Sci Dept of Comp Sci	Philippi	West Virginia	26416	Alicia Kime Gary Schubert	304-457-1700
225	University of Wisconsin				Wisconsin			
226	Marquette University	1-Programming Languages 2-Ada Programming Language	Department of Math, Statistics & Computer Science	Milwaukee	Wisconsin	53233	Dr. George Corliss	414-224-7573

Service/DoD Facilities Teaching Ada

	DoD Facility	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
1	United States Air Force Academy	1-Real-Time Systems 2-Programming Languages 3-Data Structures	Dept of Computer Science	USAFA	Colorado	80918	Capt. Gary Gregory	719-472-4171
2	NAVSEA	Ada Language System/Navy Common Ada Baseline	PMS 408	Washington	D.C.	20362		202-692-8204
3	Signal Corps Computer Science School	1-Branch Automation Officer Course 2-Systems Automation Course		Ft. Gordon	Georgia		Capt. Mike Hunter	
4	Army Management Engineering Training Activity US Naval Academy	1-Ada Programming 2-Software Engineering in Ada	AMETA	Rock Island	Illinois	61299	Bob Beat	309-782-4041 ext 218
5		1-Data Structures 2-Software Engineering	Comp Sci Dept Stop 9F	Annapolis	Maryland	21401	Major J. Spegele	301-267-3080
6	Keesler Air Force Base	1-Fundamentals of Ada Programming/ Software Engineering 2-Orientation to Ada Software Engineering 3-Ada Applications Programmer Course	3390 TCHTG/TTMKPP	Biloxi	Mississippi	39534	1LT Sandra Chandler	601-377-3728
7	Offutt Air Force Base	1-Introduction to Computer Programming 2-Software Engineering with Ada-DOS 3-Advanced Software Engineering w/Ada 4-Introduction to Software Engineering 4-Software Engineering with Ada-UNIX	HQSAC/SCRT	Omaha	Nebraska	68113	Capt. Pat Wicker	402-294-2545
8	US Military Academy	Software Engineering with Ada	Dept. Geography and Computer Science	West Point	New York	10996		914-938-2472

Service/DoD Facilities Teaching Ada

	DoD Facility	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
9	AFIT (Software Professional Development Program)	1-Software Engineering Concepts 2-Specification of Software Systems 3-Principles & Applications of SW Design 4-Software Generation and Maintenance 5-Software Verification & Validation	AFIT/ENG	Wright-Patterson AFB	Ohio	45433	LiCol Pat Lawlis	513-255-7913
10	Air Force Institute of Technology (graduate & undergraduate)	1-Intro to Data Structures and Program Design 2-Advanced Information Structures 3-Software Engineering 4-Software Analysis and Design I	AFIT/ENG	Wright-Patterson AFB	Ohio	45433	Major Paul Bailor	513-255-3708
11	Air Force Institute of Technology (Graduate Level courses)	5-Software Analysis and Design II 6-Software Generation and Maintenance 7-Principles of Embedded Software 8-Advanced Software Environments 9-Formal-Based Methods in SE	AFIT/ENG	Wright-Patterson AFB	Ohio	45433	Major Paul Bailor	513-255-3708
12	ALMC School of Engineering and Logistics	1-Software Engineering Using Ada I 2-Software Engineering Using Ada II 3-Simulation Using Ada 4-Advanced Microprocessors 5-Software Engineering Workshop	Department of Engineering Red River Army Depot	Texarkana	Texas	75507	Mark D. Oestmann	214-334-3335
13	Defense Systems Management College	1-Technical Foundations 2-Management of Software Acquisition	SE-T	Fort Belvoir	Virginia	22060	Ronald P. Higuera	703-664-3474
14	US Army Info Systems Software Center	1-Software Eng. Concepts - Ada 2-Ada Orientation 3-Ada Overview	COMMANDER, Prof Dev Center Stop H-18, Bldg 1465	Fort Belvoir	Virginia	22060	Mr. John Hovell	703-285-9839

Appendix F -
Software Design Paradigms

Software engineering currently employs a variety of paradigms in the development of software. A "paradigm" is a mechanism that illustrates a concept through the use of an example or idea that is commonly understood. These paradigms, which are used throughout the software lifecycle, provide a particular perspective of the software process. A couple of issues arise in the use of these paradigms. Is there an advantage to using the same paradigm consistently throughout the lifecycle? And secondly, is there a paradigm for software development that is superior to the others?

There are three major categories of paradigms we are considering: (1) object-oriented, (2) process-oriented, and (3) behavior or state-oriented. The object-oriented paradigm allows the software engineer to structure software around the conceptual objects of the system. Objects possess attributes and have specific functions associated with them. A process-oriented paradigm takes a functional view, highlighting system processes and data flows between those processes. A behavior-oriented paradigm provides a view based upon the system states. Objects and processes do not have to be explicitly defined in a state-based notation.

The idea of three complementary views or paradigms has been noted in both the design and requirements community. Buhr (Buhr,91) notes the existence of the structural, functional, and temporal "domains." These domains correspond to the categories of paradigms, where the structural is the object-oriented, the functional is the process-oriented, and the temporal is the behavior-oriented. Rumbaugh (Rumbaugh,91) also notes that a system can be viewed with an "object model, dynamic model, or functional model."

Techniques within the object-oriented paradigm are object-oriented design (OOD)(Booch,87) and object-oriented requirements analysis (OOA) (Coad,90). Popular techniques within the process-oriented paradigm are structured analysis (Yourdon,89) and structured design. Behavior-oriented techniques include finite state machines, Statecharts (Harel,87) and Petri nets.

One of the major advantages of using Ada is the ability to design software in an object-oriented fashion. This approach allows a software engineer to produce software that hides many of the "implementation details." Given the use of OOD, should we employ an object-oriented perspective during requirements? Not entirely. The object-oriented paradigm serves a useful role in managing software complexity during the design and implementation stages. However, an object-oriented perspective alone is not sufficient to describe requirements adequately. OOA, like its counterpart, Structured Analysis, provides the requirements reader a picture of the system objects and processes. While this is useful, we still need a way of describing the behaviors required by the implemented system. For this, we use a state machine or Petri net. Structured Analysis and OOA use some form of a state machine (finite state machine, state-event-response table) for defining the timing and behavioral requirements of a system. This use of a state machine is not part of the primary notation for either of these techniques but is an augmentation.

In addition, the goals for the different phases are not the same. During design, we want to define a structure to our software that hides unnecessary detail, promotes reliability by defining interfaces explicitly, and supports modifiability by localizing the possible changes. During requirements, we want to ascertain and describe all the desired functionality, features, and behaviors of a system that are externally visible to the user(s) and/or to other systems. From a pure requirements standpoint, we should not know how the system will be implemented (Davis, 90).

Thus, we should employ a variety paradigms (i.e., perspectives) during the requirements definition phase. And the choice of paradigms(s) should be based upon the demands of the system itself, not necessarily the intended design and implementation technique.

References

Booch, Grady, Software Engineering with Ada, Benjamin/Cummings, Menlo Park, CA, 1987.

Buhr, R.J.A., et al., "Support for Specifying Temporal Behavior in Ada Designs," Ada Letters, Vol. 11 No. 3, ACM Press, Spring 1991.

Davis, Alan M., Software Requirements Analysis and Specification, Prentice-Hall, Englewood Cliffs, NJ, 1990.

Harel, David, "Statecharts: A Visual Formalism for Complex Systems," Science of Computing, pp. 231-74, 1987.

Rumbaugh, James et al., Object-Oriented Modeling and Design, Prentice-Hall, Englewood Cliffs, NJ, 1991.

Appendix G - Tables to Support Findings

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Key for tables:

o	Support provided
s	Some support provided
o	Support expected with in the next 18 months
B	Bridge to independent tool
T	Templates
n/a	Not applicable

Tool	Software Development										DataBase Dev		If Dev					
	Spec Methods				Auto DB Population		Des Methods		Code Gen		Methods							
ADW ,RAD AGE AISLE family Auto-G AutoCode CASE 2000 CASE Station Classic Ada Cradle DCDS Design Generator EPOS Envision Excelerator Foresight HOOD-SF IEF/IEW KeyOne MODEL Maestro NETworkbench ObjectMaker Object Plus	Prototyping										DB Schema/Code Gen		Screen/Forms Design		Prototyping			
	Other										Object-Oriented Analysis		Object-Oriented Design		Other		Other	
	SA augmented										Simulation		Timing Info		Chen		Chen	
	Structured Analysis										Timing Info		Resource alloc		Requirements Extraction		Requirements Traceability	
	Simulation										Requirements Traceability		Requirements Extraction		Requirements Traceability		Requirements Extraction	
	Timing Info										Requirements Traceability		Requirements Extraction		Requirements Traceability		Requirements Extraction	
	Resource alloc										Requirements Traceability		Requirements Extraction		Requirements Traceability		Requirements Extraction	
	Other										Requirements Traceability		Requirements Extraction		Requirements Traceability		Requirements Extraction	
	Object-Oriented Analysis										Requirements Traceability		Requirements Extraction		Requirements Traceability		Requirements Extraction	
	Object-Oriented Design										Requirements Traceability		Requirements Extraction		Requirements Traceability		Requirements Extraction	
	Other										Requirements Traceability		Requirements Extraction		Requirements Traceability		Requirements Extraction	
	Auto Design Gen										Requirements Traceability		Requirements Extraction		Requirements Traceability		Requirements Extraction	
	Ada										Requirements Traceability		Requirements Extraction		Requirements Traceability		Requirements Extraction	
	C++										Requirements Traceability		Requirements Extraction		Requirements Traceability		Requirements Extraction	
	Other										Requirements Traceability		Requirements Extraction		Requirements Traceability		Requirements Extraction	

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TABLE 3. General Information

Company	Contact	Product	Subject CASE
Cadware Group, Ltd.	(203) 397-2908	Foundry	System Developer family
Index Technologies	(800) 777-8858	Customizer	Accelerator
Mark V Systems Ltd	(818) 995-7671	Tool Development Kit	ObjectMaker
Mark V Systems Ltd	(818) 995-7671	Menu Customization Kit	ObjectMaker
Reasoning Systems	(415) 494-6201	Refine	Product family
Systematica Ltd.	44 202 297 292	VSF Analyst/Designer Workbench	VSF Methods Workbench

TABLE 4. Customization and Meta CASE Tools

Company	Contact	Product	Language Support	
			Available	Planned
Cadware Group, Ltd.	(203) 397-2908	User Interface Prototyper	COBOL	
CinCom Systems Ltd.	(800) 543-3010	MANTIS	COBOL, PL/1	
Cortex Corp.	(617) 622-1900	CorVision	COBOL	
ExpertTelligence	(805) 967-1797	Action!	C	C++
Intersolve	(800) 777-8858	PVCS, APS	COBOL	
KnowledgeWare	(703) 506-0823	IEW/GAMMA	COBOL	
MAGEC Software	(800) 336-2432	MAGEC	COBOL	
Micro Focus, Inc.	(415) 856-4119	COBOL/2 Workbench	COBOL	
Netron, Inc.	(416) 636-8333	CAP	COBOL	
Relational Team Concepts	(713) 622-7400	TOP*CASE	Oracle	
Pansophic	(800) 323-7335	TELON, TELON/PWS	COBOL, PL/1	
Pansophic	(800) 323-7335	Panel Painter	COBOL, PL/1	
SINC, Inc.	(201) 391-6500	Flexgen	COBOL	
SSA, Inc.	(708) 850-9192	AS/SET	RPG/400	
Sage Software, Inc.	(800) 547-4000	APS Development Center	COBOL	
Software A&E	(703) 276-7910	SNAP/KES (formerly Spectrum)	C	
Software AG N. Am	(703) 860-5050	Predict	Natural	
Software One, Ltd.	44 0628 850444	Clarion	?	
SysCorp International	(800) 727-7837	MicroSTEP	C	
Unify Corp.	(916) 920-9092	ACCELL	COBOL	
Unisys	(215) 993-6166	LINC II	?	
Vleermuis Software Research bv	31 30 31 04 26 fax	GULMASTER	C++	

TABLE 5. Application Generators

QASE		o	
START			o
Saber-C C++ Gen			o
Teamwork	o o o	o	o o o
StP	o		o o
IEW/GAMMA	o	o	
IEF/IEW	o o		o
Excelerator	o o	o	o
Data Analyst	o		
Design/1 Case Tool	o o		
Adagen	o		
Auto-Mate Plus	o		
ADW	o		
From CASE Tool	To CASE Tool	ADW, /RAD IEW AISLE family MODEL Maestro NETworkbench PowerTools superCASE SES/workbench StP System Architect System Developer I System Developer II Teamwork	

TABLE 6. Bridges Between CASE Tools

Company	Contact	Product	Language Support	
			Available	Planned
ASA, Inc.	(214) 245-4553	Hindsight	C	Ada, C++
ATI, Inc.	(212) 354-8280	superCASE SCI	FORTRAN	
Advanced Systems Tech. Corp.		REVENGG, CAMERA		
Anderson Consulting		KBSA		
Autocase Technology		Auto-Flow Series	C, Pascal, Fortran, COBOL	
Bachman Information Systems	(617) 273-9003	Bachman Product Set	COBOL	
Bell Atlantic Systems Integration		DSFS: Reengineering Environment	COBOL	
CGI Systems, Inc.		PACREVERSE, Source/RE	C	
Cadre		Teamwork C/Rev	COBOL	
Catalyst Group	(703) 698-5100	XPRT series		
Chen and Associates		Reverse E/R Modeling		
Cincom Systems		MANTIS Entity Transformer	COBOL	
Computer Data Systems		Reeng platform, Super-Structure, SCAN/COBOL		
Cortex Corp.		CorVision, Documentor		
Deft, Inc.		DEFT		
DEC		VAXset, FUSE	COBOL, PL/I	
Eden Systems Corp.		Q/AUDITOR series		
Ernst & Young		RE/Toolset		
General Research Corp.		SLCSE	Ada, COBOL, Fortran, Jovial	
Hypersoft Corp.		HyperCode Management System	COBOL	Ada, C, C++, Pascal
IDE	(703) 848-8808	CDE		
InterPort Software Corp.	(703) 425-6425	InterCASE	COBOL	
Intersolv	(800) 777-8858	PVCS, APS, XL/Recover	COBOL	
Language Technology, Inc.	(508) 741-1507	Inspector, Recorder, Advancell		
Marble Computer, Inc.		DCD III, COBOL (CSA)		COBOL
McCabe	(800) 638-6316	BAT, CodeBreaker		
McDonnell Douglas Co.		LSRM	Ada, C, COBOL,	
Nastec	(800) 872-8296	Source/Re	FORTRAN, Pascal	
On-Line Software Inter.		InterTest, Data Vantage, Verify	COBOL	
ParcPlace Systems	(415) 691-6700	ObjectWorks/C++	C++	
Price Waterhouse Technologies		Arrae		

Procase	(408) 727-0714	SMARTsystem	C	C++
Reasoning Systems	(415) 494-6201	CLS	C	
Reasoning Systems	(415) 494-6201	Ada/RevEng	Ada	Ada, C, COBOL
SPS	(212) 686-3790	RE-SPEC	FORTRAN, Pascal	
Texas Instruments, Inc.		IEF REverse Engineering Toolset	COBOL	
ViaSoft, Inc.	(602) 952-0050	Via/Center		
XA Systems Corp.		PATHVU, DATATEC, RETROFIT		

TABLE 7. Independent Reverse Engineering Tools

Company	Contact	Product	Function	Language Support
ABRAXAS Software Inc.	(800) 347-5214	CODE CHECK	Style analysis	C, C++
Cadre Technologies Inc.	(703) 875-8670	SAW	Coverage/perf analysis	Ada, C
Computer Associates	(203) 627-8923	TRAPS	Regression testing	Independent
Donatech Corporation	(515) 472-7474	Realtime Testware	Regression testing	Independent
Dynamics Research Corp.	(508) 475-9090	AdaMAT	Quality analysis	Ada
EVB Software Engineering Inc.	(800) 877-1815	DYN	Complexity analysis	Ada
General Research	(805) 964-7724	AdaQUEST	Coverage, quality analysis	Ada
Intermetrics, Inc.	(714) 891-4631	TST	Dynamic analysis support	Ada
McCabe	(800) 638-6316	Start	DFD-driven testing	Independent
McCabe	(800) 638-6316	ACT	Complexity analysis	Ada, C, COBOL, FORTRAN, Pascal
Nokia Data	358-31-237317	TBGEN	Test bed generation	Ada
Nokia Data	358-31-237317	TCMON	Coverage analysis	Ada
Programming Environments Inc.	(201) 918-0110	T	Test data generation	Independent
RTP Software Ltd	(0252) 711414	MALPAS	Static analysis	Ada, Pascal
Set Labs	(503) 289-4758	UX-METRIC	Quality analysis	Ada, C++, C
Set Labs	(503) 289-4758	PC-METRIC	Quality analysis	Ada, C, others
Software Research Inc.	(415) 957-1441	SMARTS family	Regression testing	Independent
Software Research Inc.	(415) 957-1441	TCAT series	Coverage analysis (branch)	Ada, C, COBOL, FORTRAN, Pascal,
Software Research Inc.	(415) 957-1441	TCAT-PATH	Coverage analysis (path)	Ada, C, FORTRAN, Pascal
Software Research Inc.	(415) 957-1441	SCAT	Coverage analysis (system)	Ada, C, A
Software Research Inc.	(415) 957-1441	TSCOPE	Coverage animation	Coverage analysis
Software Research Inc.	(415) 957-1441	TDGEN	Test data generation	Independent
Software System Design	(714) 625-6147	TestGen	Coverage analysis	Ada, C
Teledyne Brown Engineering	(205) 726-1613	ACAT	Complexity analysis	Ada
Teledyne Brown Engineering	(205) 726-1613	SMART	Quality assurance	Ada
Verilog S.A.	(301) 220-2430	Logscope	Coverage analysis	Ada, C, COBOL, FORTRAN, Pascal
XA Systems Corp.	(800) 344-9223	PATHVU	Quality analysis	COBOL

TABLE 8. Stand-Alone Testing and Measurement Tools

Company	Contact	Product
AGS Management Systems	(800) 678-8484	firstCASE
ASTECH	(301) 441-9036	Camera
Atherton Technology	(301) 961-1526	Backplane
Cadre Technologies Inc.	(703) 875-8670	Teamwork/IPSE toolkit
Cincom Systems, Inc.	(800) 888-0115	AD/Advantage
General Research Corp.	(805) 964-7724	SLCSE
IBM		AD/Cycle
InfoSpan Corp.	(612) 941-2829	CaseSpan
Pansophic	(800) 323-7335	TELON/Teamwork

TABLE 9. Integration Frameworks

Company	Contact	Product	Type
Adpac Corp.	(415) 974-6699	Design	Analysis/Design tool
Arthur Anderson	(312) 5070-5161	Foundation	CASE
Arthur Anderson	(312) 5070-5161	Design/1	Workstation CASE
Bachman Information Systems	(617) 273-9003	Bachman/Analyst, /Designer	CASE
Carleton University	(613) 788-5718	TimeBench	Analysis/Design tool
Cognos	(617) 229-6600	Powercase	Analysis/Design tool
D. Appelton Company	(213) 546-7575	IDEF/Leverage	Analysis/Design tool
Michael Jackson Software	(44)71 286-1814	Jackson Workbench	Analysis/Design tool
Thought*Tools		SCOOP-3	Analysis/Design tool
On-Line Software Inter	(201) 592-0009	Casapac	Analysis/Design tool
Seer Technologies	High Productivity System	O-O CASE	Analysis/Design tool
Tom Software	(800) 777-4316	Application Xcellence	Analysis/Design tool
UES, Inc.	(614) 792-9993	KI Shell	Application integrator
Westmount Technology	(31)15-610815/(914)294-661	ISEE, TSEE, RTEE	Analysis/Design tool
Apollo (now HP)	(800) 227-6556	DSEE	Configuration management
CaseWare, Inc.	(714) 754-0308	Amplify	Configuration management
Pansophic	(800) 323-7335	PAN/LCM	Configuration management
ProMod, Inc.	(800) 255-2689	ProMod/CM	Configuration management
Procase	(609) 452-8848	Procace	Configuration management
Softool	(805) 683-5777	CCC family	Configuration management
Software Main & Dev Sys	(508) 369-7398	Aide de Camp	Configuration management
SQL Systems International	England 44-279-641021	PCMS*ADA	Configuration management
ASYST Technologies	(800) 361-3673	The Developer	Database tool
Informix Software, Inc.	(415) 322-4100	Informix-ESQL/Ada	Database tool
Ontologic	(508) 667-2382		Database tool
Oracle Systems Corp	(415) 506-7000	Case* family	Database tool
SQL Solutions	(416) 249-2246	Deft	Database tool
Advanced Logical Software	(213) 653-5786	Anatool	Diagram editor
Ascent Technologies, Inc.	(415) 940-1550	MetaView	Diagram editor generator
Cadware Group, Ltd.	(203) 397-2908	Sylva	Diagram editor
Digital Insight	(303) 674-5232	Robochart	Diagram editor
Meta Software Corp.	(800) 227-4106	MetaDesign, Design/IDEF	Diagram editor

Company	Contact	Product	Type
Software Originals, Inc.	(800) 873-6873	MacSTILE	Diagram editor
TNO	31 15 697 071	Configurable Graphical Editor	Diagram editor generator
Tata Consultancy Services	(408) 720-9584	Essay	Diagram editor
Caine, Faber, & Gordon, Inc.	(818) 449-3070	PDL/81	PDL tools
Data General	(508) 366-8911		PDL tools
Encore Computer Corp.	(301) 499-4700		PDL tools
Flexible Computer Corp.	(214) 869-1234		PDL tools
Gilmore Aerospace	(404) 728-0312		PDL tools
GTE Government Systems Corp.	(617) 449-5000		PDL tools
IBM SID	(301) 493-1448		PDL tools
Incremental Systems Corp.	(412) 621-8888		PDL tools
Intelligent Choice, Inc.	(213) 379-9680		PDL tools
Intermetrics, Inc.	(617) 661-1840	Bryon	PDL tools
Loral/Rolm Mil-Spec	(408) 423-7701		PDL tools
Phoenix International	(213) 568-1740		PDL tools
RAMTEC	(201) 477-8248	PDL Tool KIT(TM)	PDL tools
Sanders Associates	(603) 885-9208		PDL tools
SofTech	(617) 890-6900		PDL tools
ABT Corp	(212) 219-8945	Project Workbench	Project management
American Management Systems	(703) 841-6000	Life-Cycle Productivity Systems	Project management
Clarix		MacProject II, SmartForm Manager	Project management
Deloitte, Haskins, & Sells	(704) 377-3560 x3131	4Front	Project management
Index Technology Corporation	(800) 777-8858 x739	PC Prism	Project management
Project Software & Development, Inc	(301) 231-8660	Project/2	Project management
Software Publishing Corp.		HTPM	Project management
AST, Inc.	(303) 790-4242	Qase (PerSpective)	Sys perf analysis
Chen & Associates	(504) 928-5765	ER-Designer	Database tool
Cullinet Software, Inc.		IDMS/Architect	Database tool
Digital		Epitool	Expert system development
EV8 Software Engineering Inc.	(800) 877-1815	GRACE library	Ada libraries
GSI-Danet, Inc.	(703) 471-7130	OSIPRO	OSI development
Holland Systems Corp.		Logical Database Design (LDD)	Database tool

Company	Contact	Product	Type
IDDK Software		Intelligent Database Design (IDDK)	Database tool
ITWG Corporation	(619) 223-5444	Poplink	Communication analysis
Information Engineering Systems Ltd.		USER	Expert system development
Interact	(212) 696-3700	Integrator	CAE tool
Interactive Software Engineering, Inc.	(805) 685-1006	Eiffel	Programming environment
JADE Simulation Inter. Corp.	(804) 744-5849	JADE family	Simulation environment
Mass Tech, Inc.	(205) 539-8360		Ada libraries
Polyhedron Software, Ltd.	(44) 865 300579	SPAG	Formatter
Quintus Computer Systems, Inc.	(415) 965-7700	Prolog Integrated Environment	Programming environment
Simulation Software	(519) 657-8229	GP	Simulation environment
Tartan Laboratories, Inc.	(412) 856-3600	Ada Scope	Ada analysis tool
Unicad, Inc.	(800) 331-3729	UIMS, X-Pression	User interface tool
Unirel	+39 55 301279	Unirel Openlook Toolkit	User interface tool
Wolverine Software Corp.	(703) 750-3910	GPSS/H	Programming environment
Xinotech Research	(612) 379-3844	Program Composer	Ada analysis tool

TABLE 10. Other Tools

Appendix H

CASE Tools

ATI/superCASE

Information From: Gonen Ziv (212) 354-8280, May 7 1991.

Address: Advanced Technologies, Inc, 305 5th Avenue, Suite 2420, New York, NY 10118

Tool Summary: Back end CASE tool.

1. **Hardware Platforms:** VMS based for VAX mainframe, microVAX, VAX clusters etc.
2. **Products:** superCASE and superCASE SCL licensed per machine.
 - i. superCASE from \$8,000 to \$90,000.
 - ii. XL/superCASE bridge to Excelsior/RTS, provides requirements traceability \$8,500.
 - iii. superCASE SCI reverse engineering \$5,000 to \$25,000.
3. **Tool Implementation Language:** Mainly C
4. **Vendor Support:** Technical support line, training, consultancy.
5. **Marketed Since:** 1987.
6. **Size of customer base:** Over 100 installations.
7. **Methodologies/functions supported:**
 - i. **Software design:** OOD Buhr, SC methods. Capture of timing information in annotations but not used. Interface consistency checked.
 - ii. **Code generation:** Templates for Ada, C, FORTRAN, PL/1, PL/M, Jovial.
 - iii. **Maintenance:** Re-engineering for FORTRAN.
8. **Documentation generation:** 2167A support, user-definable formats.
9. **Project management support:** Configuration management built-in and standard interface to external CM tools. Security/control access.
10. **Environment Characteristics:** Multi-user, network support.
11. **Database:** Data dictionary implemented under DEC RDB. Import/export, split/merge.
12. **Links to other tools:** See XL/superCASE.
13. **Output formats:** PostScript.
14. **User interface:** Command line, menu, on-line help, some undo. Database query facility.
15. **Adaptability:** Customizable editor.
16. **Planned enhancements:** Port to UNIX, by summer '92.
17. **Collaboration with other organizations:** Negotiating with IDE (StP).

Information From: John Cox (408) 943-0630, May 8 1991.

Address: 180 Rose Orchard Way, Suite 200, San Jose, CA 95134

Tool Summary: The Requirements Driven Development System Designer (RDD-100) is based upon the early steps of DCDS, providing an improved graphical user interface. Object-oriented approach to support library for re-usable components.

1. **Hardware Platforms:** Sun, Apollo workstations, Apple Macintosh PCs, VAXstation.
2. **Components:** Maintenance primary support \$7,000, secondary support \$5,000.
 - i. **System Designer.** Equivalent to DCDS System Requirements Engineering Methodology (SYSREM) and it's System Specification Language (SSL), \$36k for single user, \$44,700 for network license. Volume discounts available.
 - ii. **RDD Design Verification Facility (RDD-DVF)** for specification simulation, \$11,365 for single user, \$13,207 network. Provides deadlock, resource utilization, system performance, communication constraints verification and analysis. Available version 3.0.
3. **Tool Implementation Language:** Smalltalk
4. **Vendor Support:** Training, consultancy. Starting support group and newsletter.
5. **Marketed Since:** 1988, currently RDD-100 Version 2.02, version 3.0 to be released July '91.
6. **Size of customer base:** Approx. 250 licenses across 16 organizations.
7. **Methodologies/functions supported:**
 - i. **System specification and design:** Some semi-automatic requirements extraction from source document. Information modeling. Some allocation of functions to hw, sw, subsystem components, some timing information captured but not all used. Traceability of system requirements and decisions. Simulation facility developed for SDIO through GE, productized for version 3.0.
 - ii. **Implementation:** Forms/screen design via customizable schema.
8. **Documentation generation:** User-definable formats, also 2167 and Mil-STD-490.
9. **Project management support:** Security/control access.
10. **Environment Characteristics:** Network support but not on-line sharing between multiple users.
11. **Database:** Database import/export via ASCII, also export contextdoc pic-ed (Mentor Graphics). Database split/merge. Using external repositories (DEC, Mentor Graphics). Allows alternative designs to be stored.
12. **Output formats:** PostScript.
13. **User interface:** Menu and mouse, windowing, some undo. Database browser/query facility.
14. **Adaptability:** User-definable documentation via modification/creation of programs. User definable hierarchy charts generated from database. Additional diagnostics can be created

by the report generator. User definable entities, relationships, and attributes to existing schema and to create new schema.

15. Planned enhancements:

- i. Version 3.0 introduces stimulus-response graphs at the system level.
- ii. Support for Interleaf.
- iii. Port to HP9000 and other HP machines, IBM RISC/AIX by end of '91.
- iv. Working with 3rd party for knowledge-based support for requirements extraction.

16. Collaboration with other organizations:

- i. DEC and Mentor Graphics.
- ii. Potentially also Cadre, Iconix and others (phase new products in, starting 3rd quarter '91).

Information From: (408) 730-2100

Tool Summary: Front-end CASE, desk top simulation and modeling system for specifying and analyzing real-time embedded software.

1. **Hardware Platforms:** Sun/UNIX and HP workstations with X-Windows.
2. **Components:**
 - i. Graphical Model Editor.
 - ii. Model Analyzer.
 - iii. Concept Prototyper.
 - iv. Library elements: reusable functions and operations, mathematical and logic, signal processing, timing and validation, data manipulation, electronic I/O panel.
3. **Tool Implementation Language:** C++
4. **Tool Price:** \$13,900. Training at Athena from \$500 per day for 1 user to \$3,000 for 6 to 10 users, on site from \$1,350 for 2 days. 30 day free evaluation.
5. **Vendor Support:** Training, consultancy.
6. **Marketed Since:** September 1988. Release 2.0 due out mid-May '91.
7. **Size of customer base:** 20 customers, some of whom have multiple copies.
8. **Software specification:** Merge of Ward-Mellor and Hatley-Pirbhai methods with explicit timing information and Ada-like mini-specs. For static analysis check syntax/semantics, diagram balancing, execution readiness, diagrams/data dictionary. Interactive/batch simulation with environment model showing hardware, software, and firmware with external events. Functional and constraint modeling, tests for reachability, non-determinism, deadlock conditions, and usage of transitions. Executable model for rapid prototyping with debugging and tracing. Animation. Can include Ada code and, in version 2.0 (1) external functional calls to pull in existing C code, (2) mini-spec I/O, and (3) bidirectional translator to/from Ada and executable mini-specs, to support import of existing code. Automated database population/change propagation.
9. **Documentation generation:** via FrameMaker.
10. **Environment Characteristics:** Network support via LAN.
11. **Database:** Proprietary object management system with published data formats. Database accessed by user-written application programs.
12. **Output formats:** ASCII (during simulation), PostScript, Nroff, FMT, Runoff, Interleaf, some plotting, HPGL.
13. **User interface:** Menus and mouse, on-line help, on-line documentation, windowing, some undo.
14. **Adaptability:** General-purpose editor.
15. **Standards conformance:** X-Windows, Extended Systems Modeling Language.

16. **Planned enhancements:** User-modifiable libraries.

CSC/Design Generator

Information From: Mitch Bassman (703) 876-1220, John Sheffler (703) 876-1223, May 8 1991.

Tool Summary: Functions as an expert assistance that automatically translates requirements into a design generation. Knowledge-based data dictionary. Modeless operation with browsers. Object-oriented implementation supports life cycle traceability. Implements CSC's Digital System Development Methodology.

1. **Hardware Platforms:** IBM PC/AT or compatible under DOS.
2. **Tool Implementation Language:** Smalltalk/V286 from Digitalk.
3. **Tool Price:** \$995
4. **Vendor Support:** Support not routinely provided.
5. **Marketed Since:** 1987, Version 2.1 released May '90.
6. **Size of customer base:** <100 installations
7. **Methodologies/functions supported:**
 - i. **Software specification:** SA, Ward-Mellor methods. Chen for information modeling. Checks diagram/data dictionary consistency, prevents invalid input. Traceability. Automated database population/change propagation.
 - ii. **Software design:** Design methods/diagrams: SD generated from requirements. Checks syntax/semantics, database/diagram consistency, complexity analysis. Forms/screen design.
8. **Documentation generation:** Customize contents (not format), no 2167A support.
9. **Project management support:** Some configuration management.
10. **Database:** Data dictionary implemented as file system. Import/export facility, with split/merge.
11. **Output formats:** PostScript.
12. **User interface:** Windowing, menus and mouse, on-line help, some undo. Browser/query facility.
13. **Adaptability:** Free-form text/graphics.

Information From: (703) 875-8670, May 8 1991.

Tool Summary: Environment that spans the design and implementation phases with real-time debug and verification tools. Supports automated transition of design to code, and helps to automate the maintenance of test information on-line as part of the CASE database.

1. **Hardware Platforms:** Sun, Apollo, DEC, HP workstations. Teamwork/OS/2 IBM PS/2 or Compaq under OS/2 includes Cadre's IPSE toolkit to allow adaptability such as customizing menus, accessing the database. RISC/AIX-based platforms. Compiler independent.
2. **Products:** Core environment \$10,000 for 1st seat and \$1,200 each additional. OS/2 version \$6,500 with RT extensions extra \$1,750. C/Rev and FORTRAN/Rev each \$8,500. Ada/Rev \$2,775. Maintenance 15%.
 - i. Teamwork/IM information modeling \$1,750.
 - ii. Teamwork/SA for Structured Analysis \$1,750.
 - iii. Teamwork/SD for Structured Design \$1,750.
 - iv. Teamwork/ADA graphic editor for Ada program design,
 - v. Teamwork/DPI document preparation interface,
 - vi. Teamwork/ACCESS database utility access,
 - vii. Teamwork/Menus for tailoring/extending Teamwork menus,
 - viii. Teamwork/ABS an Ada source builder,
 - ix. Teamwork/CSB a C source builder,
 - x. Teamwork/RqT requirements traceability (previously SAIC's THOR), \$15,000 for first, \$7,500 for each additional.
 - xi. Teamwork/SIM simulation (like Statemate). Token based simulation, \$12,000 for basic interactive version, with batch and additional performance analysis facilities \$19,000.
3. **Tool Implementation Language:** Mainly C.
4. **Vendor Support:** Hot-line, training, consultancy, users group.
5. **Marketed Since:** 1982, currently version 4.0.
6. **Size of customer base:** 15,000 copies.
7. **Methodologies and functions at different development stages supported:**
 - i. **System specification:** Hardware/software allocation via RqT.
 - ii. **Software specification:** Requirements extraction from natural English using RqT. Gane-Sarson, Yourdon-DeMarco, Ward-Mellor SA methods, and Jackson diagrams. Automatic inheritance for DFDs. Syntax/semantic, parent-child diagram balancing, consistency between diagram types, database/diagram consistency checking SIM provides simulation with performance analysis. Meller/Schlaer and ERDs for information modeling. Automated database population/change propagation. Traceability.
 - iii. **Software design:** Yourdon-Constantine, Booch-Buhr and Project Technologies object-oriented methods. Show changes needed for normalization to support database design.
 - iv. **Code generation:** SADMT, Ada, C, (C++ through Saber-C). Forms/screen design.

Cadre Technologies/Teamwork

- v. **Testing:** Via Cadre's SAW product for coverage and performance analysis.
 - vi. **Maintenance:** Re-engineering for C, FORTRAN.
8. **Documentation generation:** User-definable formats and 2167A.
 9. **Project management support:** Configuration management, own package or via Sun's NSE, VAX/s CMS. Baselineing, security/control access. Status reporting using metric from DeMarco's Bang complexity rating.
 10. **Database:** Object management system, multi-tiered. Import/export, split/merging.
 11. **Environment Characteristics:** Multi-user support, network support through LAN Manager (heterogenous and external control), multiple projects.
 12. **Links to other tools:**
 - i. Import from StP.
 - ii. Athena and Softbench integration environments.
 - iii. SQL report writer to access data dictionary information (3rd party).
 - iv. GE tools from Ada Programmers Workbench reimplemented in Teamwork.
 - v. ADAS from Research Triangle Institute.
 13. **Output formats:** ASCII, PostScript, HPGL. Interface to Interleaf, Context, Scribe, Bookmaster, WordPerfect.
 14. **User interface:** Windowing, menus/mouse, color, database query facility, undo facility. Database browser, on-line help.
 15. **Adaptability:** Free-form graphics. User-definable database entries.
 16. **Standards conformance:** CDIF.
 17. **Planned enhancements:**
 - i. Automatic transition from SA to SD.
 - ii. FORTRAN reverse engineering.
 - iii. Teamwork/T for software-based testing.
 18. **Collaboration with other organizations:**
 - i. General Electric Research and Development Center.
 - ii. Associated with Project Technology.
 - iii. PanSophic.

Cadware/System Developer I/II

Information From: Rich Giordano (800) CADWARE, May 20 1991.

Tool Summary: Rule-based approach with open architecture.

1. **Hardware Platforms:** IBM PC
2. **Products:**
 - i. SmartCASE basic method support without data dictionary \$299.
 - ii. System Developer I is centralized around the diagram editor, with a data dictionary/repository implemented in DB3 \$499.
 - iii. System Developer II centralized around the repository (proprietary database) to provide more flexibility \$3499.
 - iv. IE Information Exchange customization option (rather than a formal option). Includes IA Interaction Access option.
 - v. Foundry metatool to customize the development environment (e.g., methods and user-interface) based on RuleTool, a technique using the diagram editor to create own rule-based methods \$4999.
 - vi. User Interface Prototyper for prototyper and COBOL source code generation \$499. Available with both System Developer I and II, for II supports use of a mouse.
3. **Tool Implementation Language:** C with 8-10% assembler.
4. **Vendor Support:** Hotline, training, consultancy.
5. **Marketed Since:** System Developer I 1984, System Developer II out in June 1991.
6. **Size of customer base:** System Developer I 5000 users.
7. **Methodologies and functions at different development stages supported:**
 - i. **Software specification:** Gane-Sarson, DeMarco-Yourdon, Ward-Mellor methods, also flow charts. Shlaer-Mellor, ERDs for information modeling. Requirements extraction, traceability, capture of timing information in II. Automated database population and change propagation.
 - ii. **Software design:** Constantine method. Prototype for DB3 database design.
 - iii. **Code generation:** Forms/screen design in COBOL
8. **Documentation generation:** User-definable formats.
9. **Project management support:** Configuration management, project planning, status reporting, change reporting, security/control access in System Developer II.
10. **Environment Characteristics:** Multi-user and network support.
11. **Database:** Merge, import and export with System Developer II.
12. **Output formats:** ASCII, PostScript, other.
13. **User interface:** Menu/mouse, on-line help.
14. **Adaptability:** Methodology tailoring. Can add menu options. Cadware Ascii Netrual Diagram Interchange (CANDI) files allow definition of own diagrams, can access by CASE tool or own code for analysis etc.

Cadware/System Developer I/II

- 15. **Planned Enhancements:** X-Windows and OS/2 support.
- 16. **Collaboration:** IBM's AD/Cycle.

Computer Command & Control Co./NETworkbench

Information From: Evan Lock (215) 854-0555, May 20 1991.

Address: 2401 Walnut Street, Suite 402, Philadelphia, Pennsylvania 19103

Tool Summary: Uses rules and equational specification to generate engineering, real-time, distributed parallel processing software, supports testing and maintenance. Built-in intelligence for logical checking, design optimization, and self-documentation. Rapid prototyping and development. Changing name to Distributed Application Workbench. See also MODEL.

1. **Hardware Platforms:** VAX/VMS and IBM (VM/CMS, MVS/TSO) mainframes, Sun, DEC, IBM workstations.
2. **Products:** Technology transfer package (4 month license, 10 days training, 20 days consulting) for \$30,000 plus travel. Range from \$25,000 to \$150,000 depending on environment. 25% extra for additional language. 15% annual maintenance. Components:
 - i. Builder to generate Ada.
 - ii. Simulator to generate Ada and C.
 - iii. Manager to represent distributed run-time environment.
 - iv. Configurator integrates system components to generate programs controlling initiation/termination and managing communication and control.
 - v. Compiler to generate complete source language programs and produce test data for validation and debugging.
 - vi. Report/Screen Generator taking pictorial input to specify reports and displays.
 - vii. Test Data Generator with built-in random functions, user specifies testing rules.
3. **Tool Implementation Language:** PL/1, C, Ada, proprietary non-procedural language.
4. **Vendor Support:** Training, consultancy.
5. **Marketed Since:** 1990
6. **Size of customer base:** 4 or 5 initial sites (some government).
7. **Methodologies/functions supported:**
 - i. **Software design:** Accepts DFD input from StP (DeMarco-Yourdon, Ward-Mellor, Hatley, Gane-Sarson) or textually entered in non-procedural form (rules, formulae, operations, functions, declarations). Hardware/software allocation, timing information. Simulation for performance analysis. Relational operation optimization for database design (sequential, ISAM, VSAM, SQL). Consistency/completeness, circular logic checking, optimization.
 - ii. **Code generation:** Ada, DCL, JCL, C, PL/1. Forms/screen design via Painter.
 - iii. **Testing:** User-specifiable test data generation (random provided).
 - iv. **Maintenance:** Re-engineering for Ada, FORTRAN, C.
8. **Documentation generation:** User-definable formats. Data for 2167 available but no formats.
9. **Environment Characteristics:** Multi-user and network support via linked CASE.
10. **Database:** Repository.

Computer Command & Control Co./NETworkbench

11. **Links to other tools:** Cadre's Teamwork, Softool's CCC, IBM's VM/SE.
12. **Output formats:** ASCII.
13. **Planned enhancements:**
 - i. Automated database population/change propagation.
 - ii. Analyze to determine worst case time and show if satisfy timing requirements.
 - iii. Port to UNIX environments.
 - iv. Generation of FORTRAN.
 - v. Reverse engineering, currently working on FORTRAN and LISP.
 - vi. Generating programs for parallel processing.
 - vii. Accept object-oriented input.
14. **Collaboration with other organizations:** IBM for AD/Cycle.

CCC/MODEL

Information From: (215) 854-0555

Tool Summary: Back-end CASE for design through maintenance. Accepts DFDs or non-procedural specifications as input. Performs I/O and memory optimization.

1. **Hardware Platforms:** IBM mainframe, VAX/VMS
2. **Tool Implementation Language:** Ada, C.
3. **Tool Price:** \$25,000 to \$150,000
4. **Vendor Support:** Training, consultancy. Support Group? Newsletter?
5. **Marketed Since:** 1981
6. **Size of customer base:** Mainly used in-house, less than 5 installations.
7. **Methodologies and functions at different development stages supported:**
 - i. **Software design:**
 - a. **Methods/diagrams:** SD and OOD, depends on front-end case. Forms/screen design. Consistency, completeness, circular logic checking.
 - ii. **Code generation:** Ada, C, PL/1. Report/screen generation.
 - iii. **Testing:** Automated test data generation either by user specified rules or random.
8. **Documentation generation:** User-definable formats. 2167A information available, no report formats.
9. **Project management support:** via front-end case.
10. **Environment Characteristics:** via front-end case.
11. **Database:** via front-end case, separate database not maintained.
12. **Links to other tools:** Interface to Teamwork, StP, potentially DEC's DecDesign.
13. **Output formats:** ASCII.
14. **User interface:** via front-end case.

Computer System Advisors/POSE

Information From: Irene Nechaev (800) 537-4262

Address: 50 Tice Blvd., Woodcliff Lake, NJ 07675

Tool Summary: Picture Oriented Software Engineering (POSE) for systems planning and business area analysis, analysis, design, construction of information systems.

1. **Hardware Platforms:** IBM PC-XT, PC-AT, PS/2 or compatible, under DOS, OS/2. Macintosh.
2. **Products:** POSE alone \$2,665; with FlexGen \$3,995.
 - i. Data model toolkit, any single module \$595, toolkit for \$1195:
 - a. POSE-DMD Data Model Diagrammer
 - b. POSE-DMN Data Model Normalizer
 - c. POSE-LDD Logical Database Designer
 - d. POSE-DBA Database Aid
 - ii. Process model toolkit, any single module \$595, toolkit for \$1195:
 - a. POSE-DCD Decomposition Diagrammer
 - b. POSE-DFD Data Flow Diagrammer
 - c. POSE-SC Structure Chart Diagrammer
 - d. POSE-ACD Action Chart Diagrammer
 - iii. POSE-SRP Screen Report Prototyper \$595.
 - iv. POSE-PMD Planning Matrix Diagrammer for business analysis/planning \$595.
 - v. Data Model Bridge (DMB) for uploading data models to KnowledgeWare's IEW \$595.
 - vi. LAN support \$595.
3. **Tool Implementation Language:** COBOL
4. **Vendor Support:** Training, consultancy, twice yearly newsletter.
5. **Marketed Since:** 1979 in Europe, 1982 in USA. Preparing to release POSE Version 4.2 with reverse schema engineering, increased import/export functionality, complete data model integration and advanced utilities and input.
6. **Size of customer base:** User base of over 2,500 worldwide.
7. **Methodologies/functions supported:**
 - i. **Software specification:** Yourdon, Gane-Sarson methods. Diagram balancing, consistency. Information engineering using Chen, Merise. Libraries for reuse of objects. Automated database population/change propagation.
 - ii. **Software design:** Constantine method. Database design.
 - iii. **Code generation:** COBOL through FlexGen. Schema generation for various database including DB2, SQL. Forms/screen design with prototyping.
 - iv. **Maintenance:** Reverse schema engineering to allow importing existing database schemas to populate the DMD data dictionary for new applications.

Computer System Advisors/POSE

8. **Documentation generation:** User-definable report generation.
9. **Project management support:** Security/control access, project planning, status reporting, change reporting. Configuration management.
10. **Environment Characteristics:** Network support but not multi-user.
11. **Database:** Data dictionary implemented as a database with published interfaces. Database split/merge. Import/export function for exchange of information with other CASE tools. Also ASCII file generation.
12. **Links to other tools:**
 - i. Generates code via link to FlexGen (from SINC, Inc.) which provides 4GL programming language, rapid prototyping, source code generation, user query, and report tools.
 - ii. DMB for uploading data models to KnowledgeWare's IEW.
 - iii. Export via ASCII to code generators, some existing interfaces.
 - iv. IBM's CSP application generator.
13. **Output formats:** HPGL, ASCII.
14. **User interface:** Menu and mouse, color, windowing. Database browser/query facility, on-line help.
15. **Adaptability:** Free-form text/graphics.
16. **Planned enhancements:**
 - i. MS Windows and IBM OS/2.
 - ii. Multi-user version end '91 or early '92.
17. **Collaboration with other organizations:** Conformance with IBM's Ad/Cycle.

Computer System Advisors/SILVERRUN

Information From: Irene Nechaev (800) 537-4262

Address: 50 Tice Blvd., Woodcliff Lake, NJ 07675

Tool Summary: SILVERRUN series support rule-based building and refining of data models, generation of SQL, and building/validating DFDs.

1. **Hardware Platforms:** Mac PC
2. **Components:** It consists of a Relational Data Moduler (RDM) module, a Data Flow Diagrammer (DFD) module, and an Entity Relationship Expert (ERX) module. Preparing Release 2.0.5. operates under X-Windows, OS/2. Each of the 3 modules costs \$2,500.
3. **Tool Implementation Language:** C++
4. **Vendor Support:** Training, consultancy, hot-line, newsletter. Users group being established.
5. **Marketed since:** 1988
6. **Size of customer base:** 3000 licenses
7. **Methodologies and functions at different development stages supported:**
 - i. **Software specification:** Supports Gane-Sarson, Yourdon-DeMarco with ERDs for information modeling.
 - ii. **Software design:** Database design with schema generation for Ingres, DB2. Screen/forms prototyper.
8. **Documentation generation:** User-definable formats.
9. **Database:** Data dictionary implemented as database.
10. **Output formats:** ASCII.
11. **User interface:** Menu and mouse, windowing, color.
12. **Adaptability:** Free-form text/graphics.
13. **Planned enhancements:**
 - i. Integration with POSE.
 - ii. Generation of C code, late 1991.
 - iii. Multi-user, network support, later 1991.

Information From: Eric Rivas (713) 480-3233, May 21 1991.

Address: 17629 El Camino Real, Suite 202, Houston, TX 77058

Tool Summary: Backend CASE tool to support requirements definition, objects analysis, and code generation, does not support graphical analysis of application problem space.

1. **Hardware Platforms:** IBM AT
2. **Products:** Basic system \$1,990, with Ada code generator \$2,490. Volume discounts available.
3. **Tool Implementation Language:** C
4. **Vendor Support:** Training, consultancy, hot-line, bulletin board.
5. **Marketed Since:** 1989
6. **Size of customer base:** 700 licenses
7. **Methodologies and functions at different development stages supported:**
 - i. **Software specification:** CORE method with application-tailored requirements templates. Object-oriented Analysis using the Coad/Yourdon method. Information matrix analysis. Traceability. Auto database population/change propagation.
 - ii. **Software design:** Object-oriented Design. Schema generation for DB2, Oracle, SQL/D, dBASE, Paradox, and others.
 - iii. **Code generation:** Ada, C++, C, Turbo Pascal.
 - iv. **Maintenance:** Re-engineering for C and C++.
8. **Documentation generation:** Customizable and 2167A templates.
9. **Project management support:** Version control.
10. **Environment Characteristics:** Multi-user and network support.
11. **Database:** Object-oriented repository implemented as a database. Import/export in flat files and Common Delimited ASCII. Database split/merge.
12. **Output formats:** ASCII.
13. **User interface:** Menu and mouse, windowing, on-line help, database browser/query facility.
14. **Adaptability:** Some methodology tailoring.
15. **Planned enhancements:**
 - i. X-Windows/Motif version.
 - ii. Inheritance.
 - iii. General-purpose graphical editor.

Information From: Leon Stucki (206) 939-7552, 23 may 1991.

Tool Summary: Formerly Design Vision by Ken Orr Institute.

1. **Hardware Platforms:** IBM PS/2 under OS/2.
2. **Tool Implementation Language:** C
3. **Tool Price:** Single user \$7,500. Volume discounts available.
4. **Vendor Support:** Training, consultancy, support group, newsletter.
5. **Marketed Since:** 1986
6. **Size of customer base:** Around 600 installations.
7. **Methodologies and functions at different development stages supported:**
 - i. **Software specification:** SQL interface provides some support for requirements extraction. Structured Analysis, with limited support for real-time extensions. Chen information modeling. Automated database population/change propagation.
 - ii. **Software design:** SC.
 - iii. **Code generation:** User-definable templates for some C generation. Schema generation via link to Olivetti products, tool provides some itself.
8. **Documentation generation:** User-definable formats.
9. **Project management support:** Security/control access.
10. **Environment Characteristics:** Multi-user and network support.
11. **Database:** Object-oriented repository implemented as database. Import/export facility.
12. **Links to other tools:**
 - i. Link to Olivetti products for forms/screen design and schema generation.
 - ii. Link from Brackets to Envision (Envision to Brackets planned).
13. **Output formats:** ASCII.
14. **User interface:** Menu and mouse, windowing, color, on-line help. Database browser/query facility.
15. **Adaptability:** Free-form text/graphics, some methodology tailoring.
16. **Planned enhancements:**
 - i. Link to MicroSoft's Project for project management support.
 - ii. Reverse engineering.
 - iii. Link to Olivetti products for prototyping.
 - iv. Simulation.
 - v. Integrate Brackets with Envision.
17. **Collaboration with other Organizations:** IBM AD/Cycle.

Information From: May 6, 1991.

Address: 22 Third Avenue, Burlington, MA 01803

Tool Summary: Workstation-based graphical support for simulation and prototyping. Executable specification for real-time software, screen display forms. Test data used to emulate system environment and uncompleted portions of system. Color animation of diagrams.

1. **Hardware Platforms:** Sun with UNIX and SunOS, VaxStation with MicroVMS and UIS software, Apollo/Aegis with DomainIX. VAX/VMS, RISC-based Sun and DEC workstations, IBM PC/AIX.
2. **Products:** Each with kernel (3 graphics editors) and training for 2 people. Maintenance 15%.
 - i. Statemate Analyzer \$25,000.
 - ii. Statemate Prototyper to generate code \$30,000 (for either Ada or C).
 - iii. Statemate Documentor for customized output includes Statemate Dataport to access outside elements and database, \$20,000.
 - iv. EXPRESS VHDL.
3. **Tool Implementation Language:** C
4. **Vendor Support:** Training, consultancy, technical support line.
5. **Marketed Since:** 1987
6. **Size of customer base:** Approx 700 copies.
7. **Methodologies and functions at different development stages supported:**
 - i. **System specification:** System definition and specification, system requirements analysis and design (with EXPRESS VHDL for hardware specification), system integration and testing, validation testing. Simulation with state reachability, deadlocks, race conditions.
 - ii. **Software specification:** David Herel's method with activity charts, data dictionary entries, state charts (concurrency and hierarchy, extension of state transition diagrams), module charts (physical system architecture). Some timing information, concurrency. Consistency/completeness checks of model. Automatic change propagation. Dynamic and behavioral validation, interactive/batch simulation, dynamic reachability and non-determinism testing, no dynamic timing or hardware allocation. Traceability.
 - iii. **Software design:** Module charts (not SC). Traceability between design elements and forms (formal and informal textual information such as requirements list). Forms editor,
 - iv. **Code generation:** Ada, C
8. **Documentation generation:** Text and graphics, user-definable and built-in templates (including 2167A templates).

9. **Project management support:** Configuration management, logging and versioning of files, security/control access, status reporting, change reporting.
10. **Environment Characteristics:** Multi-user, no replication.
11. **Database:** Repository of ASCII files used like native DBMS (InterBase). DATAPORT facility via C routines for import/export of ASCII data, provides bridge to other tools. Database split/merge.
12. **Links to other tools:**
 - i. DesignAid: Network support using IBM PC-Network and Novell Advanced NetWare.
 - ii. Uses RDB from MicroVAX, Interbase from Sun and Apollo.
13. **Output formats:** ASCII, PostScript, Interleaf, troff, nroff, HPGL.
14. **User interface:** Menu and mouse, windowing, color, on-line help, 1 level of undo. Menu-driven query facility for database.
15. **Adaptability:**

Graphic editors are rule-based with automatic syntax checking.
16. **Standards conformance:** EXPRESS VHDL (1076 compliant VHDL).
17. **Planned enhancements:** Design to test link for performance analysis, end of '91.

IDE/Software through Pictures (StP)

Information From: Lesley Mangeri (703) 848-8808

Tool Summary: Open architecture called Visible Connections with published interfaces.

1. **Hardware Platforms:** DEC VAXstation, Sun, HP/Apollo workstations, IBM RISC, and others under UNIX, X-Windows.
2. **Products:** \$5,000 to \$12,000
 - i. OOSD/Ada Release 1.0. Release 1.1 will include code generation from designs, 2167A support, X-Windows support (summer '91), and reverse engineering 92.
 - ii. OOSD/C++ with graphical design editor, expected end '91.
 - iii. CDE Phase I released 1990. Reverse engineering and code generation in Phase II. Integrated between design and construction tools.
 - iv. StP Integrated Structured Environment with Document Preparation System with 2167 and user-definable report templates. Document browsing capability, interface with external work processing systems. Mixing text/graphics. Comes with each of above modules.
 - v. Rapid prototyping tool.
3. **Tool Implementation Language:** C, C++, Ada.
4. **Vendor Support:** Training, quarterly newsletter, consultancy, support group, hot-line.
5. **Marketed Since:** 1985. Currently release 4.3.
6. **Size of customer base:** 4000 installations.
7. **Methodologies and functions at different development stages supported:**
 - i. **Software specification:** Gane-Sarson, Yourdon-DeMarco, Hatley methods. No explicit timing or other quantitative performance information, replication, resource allocation. Chen and Jackson data structure diagrams for information modeling. Diagram and decomposition checking, consistency with database and between diagram types. Automated database population and change propagation on demand. Traceability.
 - ii. **Software design:** Structure charts, mini-specs. Supports Wasserman's User Software Engineering for interface design and prototyping. Parameter checking for static analysis. Database design with SQL schema generation for various relational databases including DB2, Informix, Ingres, Interbase, Oracle.
 - iii. **Code generation:** User-definable source code templates for Ada, C, Pascal, PDL for data and type declarations from design descriptions. Structured Chart Editor templates for COBOL. RAPID/USE code for user interface development.
 - iv. **Testing:** For SA/SD portion via bridge to McCabe's tools.
8. **Documentation generation:** User-defined and 2167A templates.
9. **Project management support:** Security/control access.
10. **Environment Characteristics:** Multi-user and network (heterogeneous) support. Multiple project support.
11. **Database:** Object management library (repository) implemented as relational database, user-definable schema with data independent interface to data dictionary. Database

IDE/Software through Pictures (StP)

split/merge, import/export with defined data formats.

12. Links to other tools:

- i. Atherton's Software Backplane.
- ii. 4GLS
- iii. Interleaf and FrameMaker publishing.

13. Output formats: PostScript, troff, UNIX pic, raster.

14. User interface: Menu and mouse, windowing, on-line help, undo. Database browser.

15. Adaptability: Object Annotation Editor to associate properties and values with diagram objects based on user-defined annotation templates. Annotation information extracted from data dictionary via Object Management Language, Documentation Preparation System, or Troll DBMS facilities. Special tool for limited methodology tailoring.

16. Standards conformance: CDIF.

17. Planned enhancements:

- i. RISC/AIX platforms 3rd quarter 90, single license \$5,000 to \$21,000.
- ii. Expect generation of C++ (through Saber-C) next year.
- iii. Reverse engineering.

18. Collaboration with other organizations:

- i. Group Bull for their internal use.
- ii. Saber Software (for C coding, testing and re-engineering).
- iii. Informix Software, joint marketing agreement. SQP support.

Information From: Neil McCoy (703) 391-2771, May 7 1991.

Address: 2800 28th Street, Suite 320, Santa Monica, CA 90405

Tool Summary:

1. **Hardware Platforms:** All on Macintosh PCs, FreeFlow under DOS windows and Sun/UNIX. AdaFlow Sun/UNIX by fall 1991, other environments by end of year.
2. **Products:** PowerTools/RT, PowerTools/MIS, PowerTools/Ada each \$4,995. PowerTools/Engineering \$5,995. PowerTools/AdaVantage, PowerTools/LifeCycle \$6,995. Training approx \$500 a day, on methodology via 3rd party. Components:
 - i. AdaFLOW hierarchical Buhr/Booch diagram editing with dictionary and language sensitive editing support, \$1,995.
 - ii. Free Flow support for DeMarco/Hatley.
 - iii. Fast Task real-time SA extensions.
 - iv. DataModeler for modeling and logical database design.
 - v. QuickChart shows partition of software into modules (Constantine).
 - vi. SmartChart structure chart generator.
 - vii. PowerPDL translates pseudo-code into trees needed for SmartChart and generates formatted documentation.
 - viii. ASCII Bridge merges multiple dictionaries and import/export facility.
 - ix. CoCoPro.
3. **Tool Implementation Language:** Pascal and C.
4. **Vendor Support:** Training, consultancy.
5. **Marketed Since:** 1986
6. **Size of customer base:** 1500 copies
7. **Methodologies/functions supported:**
 - i. **Software specification:** Can import requirements specification from Teamwork. DeMarco and Hatley/Ward-Mellor. Schlaer-Mellor OOA methods, Chen, Martin methods and IDEF1X, ERA editor for information modeling. Consistency, diagram balancing, database/diagram consistency checking. Traceability in AdaFLOW via comments in data dictionary. Automated database population/change propagation.
 - ii. **Software design:** Constantine SD with Page-Jones extensions, Structured Object-Oriented Design (SOOD) in AdaFlow. PDL with document generation. DataModeler builds textual source files containing SQL, COBOL, or other source language data definitions for database design.
 - iii. **Code generation:** QuickChart for C, C++, etc. (Pascal, Modula-2, LISP, Prolog, FORTRAN, PDL, Jovial). AdaFlow for Ada.
 - iv. **Maintenance:** Re-engineering via SmartCheck, PDL for software developed using tools.
8. **Documentation generation:** User-defined and 2167A templates.

9. **Database:** Data dictionary implemented as file system, together with diagrams maintained as integrated encyclopedia. Multiple typing in data dictionary.
10. **Project management support:** CoCoMo cost modeling. Security/control access, configuration management via ASCII Bridge, export after date stamping.
11. **Environment Characteristics:** Multi-user, network support.
12. **Database:** Import/export to DBMS via ASCII Bridge. Split/Merge.
13. **Links to other tools:**
 - i. See ASCII Bridge.
 - ii. Teamwork for requirements.
14. **Output formats:** ASCII, Interleaf. In Mac environment support WordPerfect and such.
15. **User interface:** Menu and mouse, windowing, color, undo facility, database browser.
16. **Standards conformance:** CDIF
17. **Planned enhancements:**
 - i. Publish and subscribe to replace cut and paste and allow automatic updating.
 - ii. All tools under DOS Windows and Sun/UNIX. Release on multiple platforms e.g., combination of UNIX and DOS environments.
 - iii. Requirements traceability tool, fall '91.
 - iv. Potentially link to Advanced Systems Technology, Inc.'s QASE RT for simulation.
18. **Collaboration with other organizations:**
 - i. Joint marketing venture with Meridian for purchase with Meridian Ada Vantage compiler.
 - ii. IBM Ad/Cycle.

Index Technologies/Excelerator

Information From: Julie Kelly (800) 777-8858, hot-line (800) 888-4203. May 7 1991.

Address: One Main Street, Cambridge, MA 02142

Tool Summary: Planning, analysis, design, construction and re-engineering of information systems, supporting overview of a database and interacting application.

1. **Hardware Platforms:** IBM PC/DOS, VAXstation/VMS.
2. **Products:** Maintenance \$882 per copy.
 - i. Excelerator/IS, includes XLDictionary for integration project information \$9,800.
 - ii. Excelerator/RTS, includes XLDictionary for integration project information \$9,800.
 - iii. XL/DOC add-on for documentation generation to user-specified formats/scripts \$4000.
 - iv. PC Prism supports both IS and RTS, computer aided system planning \$8000.
 - v. Excelerator for Design Recovery for re-engineering of COBOL. Taking off market.
 - vi. Customizer package to tailor Excelerator, modify graphs, screen descriptions \$12,500.
 - vii. XL/Quickstart provides on-line assistance for using Excelerator.
 - viii. IDEF/LEVERAGE, a custom version of Excelerator to automate IDEF modeling.
3. **Tool Implementation Language:** C++
4. **Vendor Support:** Publishes CASE magazine. Training, consultancy, hot-line, support group and newsletter.
5. **Marketed Since:** About 1984. Currently release 1.9.
6. **Size of customer base:** 100,000 installations.
7. **Methodologies/functions supported:**
 - i. **Software specification:** Yourdon, Gane-Sarson, Ward-Mellor, Hatley, SSADM methods. Chen and Merise ERDs for information modeling. Diagram balancing, syntax/semantics, database/diagram consistency checking. Automated database population/change propagation. Traceability of engineering and user requirements.
 - ii. **Software design:** Constantine charts, Jackson structure diagrams. Verifies normalization to support database design.
 - iii. **Code generation:** Transform database record descriptions into BASIC, C, COBOL, PL/1. Forms/screen design with prototyping in Basic, C, COBOL, PL/1.
8. **Documentation generation:** Customizable and user-definable formats, 2167A support.
9. **Project management support:** Access control, assignment to project tasks, workbreakdown structure diagrams, presentation graphs.
10. **Environment Characteristics:** Central project dictionary. Multi-user, network support. Database split/merge facility, multiple project support. Access to database by XL/Programmer Interface. Export to dBASE II, and other databases.
11. **Links to other tools:**
 - i. Bridge to IBM CSP and JAD, DB2. Rep (PC Prism).
 - ii. 4FRONT integration framework from Deloitte & Touche.

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- iii. Bridge by XL/Interface to TELON for prototyping or MicroFocus COBOL/2 Workbench.
 - iv. Bridge to Sage's APS Development Center.
 - v. XL-XPRESS bridge to PSL/PSA.
 - vi. Interface to Aldus PageMaker, GDDM, Ventura Publisher.
 - vii. Softool's CCC.
 - viii. Applied Business Technology's Project Workbench.
 - ix. Interface to other application generators for COBOL.
 - x. Interface to 4GL MANTIS, PowerHouse.
12. **Output formats:** PostScript, HPGL. Interleaf for VAX version.
13. **User interface:** Menu and mouse, windowing, color, some on-line help. Database query/browser.
14. **Adaptability:** Free-form text/graphics via Customerizer package.
15. **Standards conformance:** SAA next version.
16. **Planned enhancements:**
- i. Improved static analysis, executable specs with Petri-nets.
 - ii. Support for OS/2.
17. **Collaboration with other organizations:**
- i. IBM partner, AD/Cycle.
 - ii. Merged with Sage, supporting APS application generator. (Sage now called Intersolve.)

Integrated Systems/AutoCode

Information From: Bruce Donadt (508) 393-1231, May 8 1991.

Address: 2500 Mission College Blvd., Santa Clara CA 95054-1215

Tool Summary: Graphical environment for mathematically-based design of real-time control systems with design capture, simulation and code generation in Ada, C, Fortran. Automates development of real-time software from SYSTEM_BUILD's high-level graphical design. 2 and 3D plotting.

1. **Hardware Platforms:** VAXstation, HP/Apollo, SUN workstations, IBM PC.
2. **Components:** Single-user workstation from \$20,000 to \$43,000. Multiple licenses multiple by factor of 1.4, and factor of 2.4 for multi-user licenses. This purchases full support and use of software for 1 year, must renew at 20% each subsequent year.
 - i. SYSTEM_BUILD for graphical modeling and simulation of nonlinear, continuous, event driven and sampled-data systems. Includes Case Extension Module, RT/Expert Module, RT/Fuzzy Module. Simulation enhancements include Interactive Animation Module, HyperBuild Module, RemoteSim Module.
 - ii. MATRIXx Analysis and Design for interactive control system analysis and design.
 - iii. Xmath scientific and engineering mathematics, graphics, and programming.
 - iv. AutoCode Real-Time Code Generation generates code directly from high-level SystemBuild block diagrams in Ada, C, FORTRAN.
 - v. AC-100 Implementation and Testing supports testing of control software and hardware.
3. **Tool Implementation Language:** C++ (and others for math routines).
4. **Vendor Support:** Newsletter, training, consultancy, support group, hot-line.
5. **Marketed Since:** SYSTEM_BUILD since 1983, AutoCode (SystemBuild + code generation module) since '86. Currently release 2.04.
6. **Size of customer base:** 600-700 installations.
7. **Methodologies/functions supported:**
 - i. **System specification:** Graphical model, ST, global data stores, finite state machines. Information modeling. Hardware/software allocation. Simulation with timing information, can include code in any compilable language. Automated database population/change propagation. Traceability.
 - ii. **Code generation:** Ada, C, FORTRAN.
8. **Environment Characteristics:** Multi-user and network support.
9. **Database:** No import/export. Data dictionary implemented as database. Database split/merge. User Code Block interface allows Ada, FORTRAN, C modules to be added to the library.
10. **Output formats:** PostScript, Interleaf.
11. **User interface:** Menu and mouse, windowing, color, on-line help.

Integrated Systems/AutoCode

12. **Standards conformance:** Next release X-Windows under Motif.
13. **Planned enhancements:**
 - i. Document generator (summer '91) will provide user-definable templates and 2167 documentation aids.
 - ii. Open architecture allowing import/export from/to other CASE tools.

KnowledgeWare Inc./Application Development Workbench

Information From: Brenda Watkins (703) 506-0823 x7040, Jeff Wiley for technical support.

Address: 3340 Peachtree Road, N.E., Atlanta, GA 30326

Tool Summary: Set of integrated rule-based CASE tools running on micros designed to develop applications for mainframe IBM environments. Tools integrated round central object-oriented encyclopedia, likely to be kernel of IBM's repository product. Re-use support.

1. **Hardware Platforms:** IBM PS/2, OS/2 with Presentation Manager.

2. **Products:**

- i. Application Development Workbench (ADW) comprises the Design Workstation, Construction Workstation, Planning Workstation, and Analysis Workstation. The Starter Kit is \$15,000. ADW/MVS operates in a mainframe environment (MVS/TSO), an open architecture framework that can be used with PWS CASE tools, IEW, and ADW.
- ii. ADW/RAD for application animation and automated generation of design information from specification. Uses object-oriented methods and a non-procedural specification language. Purchased separately costs \$1,500, or with ADW/DOC for \$2000. Executes on IBM PS/2. It focuses on a tactical or business area analysis project and the associated analysis and design to drive application development of the business model. It can be driven by the process and data models defined by the ADW/Analysis Workstation. Application Animator for iteratively prototyping the specification. Application Design Generator to generate the application design (screen layouts, action diagrams, structure charts and data structures) into the ADW/Design Workstation (2nd release). Initial version targeting text-base applications, subsequently GUI applications.
- iii. ADW/DOC for documentation support. Purchased separately costs \$1,500, or with ADW/RAD for \$2000.
- iv. GAMMA COBOL generator \$209,300 for first license.
- v. Repository Enablement Facility provides a bridge between KnowledgeWare's encyclopedia and RM/MVS.
- vi. IEW Starter Kit is \$15,000.

3. **Tool Implementation Language:** C

4. **Vendor Support:** Training, consultancy, newsletter, hot-line, support group.

5. **Marketed Since:** IEW since 1985, ADW since 1990.

6. **Size of customer base:** 55k copies, >3k sites.

7. **Methodologies/functions supported:**

- i. **Software specification:** Yourdon-DeMarco, Gane-Sarson, Ernst-Young methods. James Martin's Object Oriented Analysis, and ERDs for information modeling. Simulation via ADW/RAD. Syntax/semantics, diagram balancing, database/diagram consistency, consistency with planning stage checking; the Knowledge Coordinator around the encyclopedia ensures referential integrity, consistency, etc. Traceability.

- Automated database population and change propagation.
- ii. **Software design:** SC and module action diagrams generated from specification. Screen/forms design and prototyping. Generate SQL Data Definition Language, COBOL for database.
- iii. **Code generation:** Templates for C, Ada, COBOL, FORTRAN, Pascal, PL/1, and others.
- iv. **Maintenance:** Re-engineering from COBOL.
- 8. **Documentation generation:** User-definable and 2167A templates via ADW/DOC.
- 9. **Project management support:** Audit trail, security/control access, some project planning.
- 10. **Environment Characteristics:** Multi-user, network support via LAN.
- 11. **Database:** Repository with split/merge, import/export facility.
- 12. **Links to other CASE tools:**
 - i. Mark V's Adagen/KW001 interface extensions for Ada generation for IEW/AWS.
 - ii. Software One Ltd. interface from Auto-Mate Plus to IEW/ADW, from Teamwork to IEW/ADW, and between IEF and IEW.
 - iii. Barton Group interface IEF to IEW or ADW, and with INGRES/Pansophic.
 - iv. Fina Oil interface from Excelerator to IEW and between Design/1 CASE Tool and IEW.
 - v. Computer Associates interface with Architect.
 - vi. Cortex Ltd. interface from IEW/DWS to CorVision.
 - vii. EDS interface from IEW/AWS (soon IEW/ADW) to Pacbase.
 - viii. Comp. Eng. Cons. bi-directional interface for IEW/ADW and CEC's Analyst Workbench.
 - ix. Software AG interface from IEW/ADW to Predict (also Excelerator to Predict).
 - x. U.S. Sprint interface from Prokit Workbench to IEW.
- 13. **Links for reverse engineering:**
 - i. InterCASE for transfer of data to IEW/AWS and IEW/DWS.
 - ii. Utilities for database reverse engineering.
- 14. **Links to code generators:**
 - a. TELON code generator for COBOL and PL/1.
 - b. Barton Group working on bi-directional interface between IEW/AWS and Bachman's Data Analyst. Also Bachman interface from IEW/AWS to Data Analyst.
 - c. Ernst & Young interface from IEW/DWS into Microfocus Workbench for generation of object code from IEW's COBOL.
 - d. Bi-directional interface between IEW and Uniface (4th gen application development system).
 - e. Bonner & Moore Consulting interface to Netron's Cap.
 - f. Interface to Clarion code generator.
 - g. APS/IEW PC Interface for bridge from IEW/AWS to Sage's APS. Bi-directional IEW/DWS interfaces by John Deere.
 - h. SAA interface from IEW/DWS to AS/SET code generator for RPG/400.
 - i. KnowledgeWare's bi-directional interface to IBM's CSP and own COBOL generator.

- j. Pro-C code generator for C.
- 15. **Output formats:** ASCII, PostScript.
- 16. **User interface:** Menu and mouse, windowing, color, on-line help with hypertext. Database browser/query facility.
- 17. **Adaptability:** Free-form text/graphics, some methodology tailoring.
- 18. **Standards conformance:** IBM SAA, National Language Support (NIS).
- 19. **Planned enhancements:**
 - i. Real-time extensions to be released in January 1992.
 - ii. C generation in 1992.
- 20. **Collaboration with other organizations:** IBM AD/Cycle.

Information From: Giovanna Petrone 39 11 831.1830, FAX 39 11 812.1235

Email: giovanna@lps@i2unix.uucp

Address: Via Napione 25, 10124 Torino, Italy

USA distributors for Ada products: (703) 648-1551

Tool Summary: For detailed, programming, and documentation of software projects using Ada, C, C++, FORTRAN, COBOL, Pascal, and others. Uses hypertext technology. Formerly DUAL and KEYLINE.

1. **Hardware Platforms:** DEC VAX/VMS, Sun and Apollo workstations, IBM PS/2 and RISC systems, PC, HP series 9000.
2. **Products:** The full KeyOne package (for Ada) starts at \$895 for IBM PC. C++ package starts at \$2,850 on workstations. Ranges up to \$21,400 for Ada or C++ on VAX 8974, 8840, 8978, 6360, 6333, 8842. Maintenance is 15% of license price, with updates during maintenance period costing \$300.
 - i. KeyFlex hybrid editor ranges from \$295 (Ada) and \$1,800 (C++) to \$15,000.
 - ii. KeyDesign syntax directed editor for design.
 - iii. KeyDoc structured documentation generator.
 - iv. Off-the-shelf translators for Pascal to Ada, Ada PDL to C, HOOD PDL to Ada or C.
 - v. Intermodule navigation for KeyOne for Ada 15% of Ada license price.
 - vi. DoD 2167A documentation support 15% of license price.
 - vii. SQL extension to standard languages (C, COBOL, Ada) 10% license price.
3. **Tool Implementation Language:** C
4. **Vendor Support:** Consultancy, training, hot-line.
5. **Marketed Since:** DUAL introduced in 1982, KeyOne in 1987.
6. **Size of customer base:** >600 installations
7. **Methodologies and functions at different development stages supported:**
 - i. **Software design:** Step-wise refinement with James Martin action diagrams. Automated database population/change propagation?
 - ii. **Code generation:** Ada, C, C++, Pascal, FORTRAN, COBOL.
 - iii. **Maintenance:** Re-engineering for Ada, C, C++, FORTRAN, Pascal.
8. **Documentation generation:** User-definable formats, 2167A templates.
9. **Project management support:** Security/control access.
10. **Environment Characteristics:** Multi-user, network support.
11. **Database:** Data dictionary implemented as file system. Import/export?
12. **Output formats:** PostScript.
13. **User interface:** indowing, on-line context-sensitive help, undo facility.

14. **Planned enhancements:** Translators are being developed for Jovial to Ada, FORTRAN to Ada or C, Ada to HOOD PDL reverse translator.

Mark V Systems Ltd./ObjectMaker

Information From: Grace Farenbaugh (818) 995-7671, May 7 1991.

Address: 16400 Ventura Blvd., Suite 303, Encino CA 91436

Tool Summary: Code generation and reverse engineering for Ada, C, C++. Extensibility a major feature. Designed to facilitate rule-based integration with other methods/tools.

1. **Platforms:** IBM PC/DOS, MACs, and under UNIX/Windows for any workstation.
2. **Products:** As a whole, ObjectMaker CASE Tool (analysis/design, menu customization, and 1 language) \$8,000. Volume discounts available. Maintenance 15% source price.
 - i. ObjectMaker Analysis and Design, drawer, database repository, and methods support \$5,000.
 - ii. ObjectMaker Tool Development Kit (TDK) provides access to rules for extensive customization \$25,000.
 - iii. Menu customization kit for menus and acceleration keys \$1,500.
 - iv. Adagen language module for Ada code generation and reverse-engineering \$3k.
 - v. Cgen language module for C, C++ code generation and reverse-engineering \$3k.
3. **Tool Implementation Language:** C, Prolog, Ada.
4. **Vendor Support:** Training, consultancy. Starting a support group and newsletter.
5. **Marketed Since:** AdaGen since 1986, ObjectMaker Version 1.8 since April '91.
6. **Size of customer base:** 500 seats, 80 organizations.
7. **Methodologies/functions supported:**
 - i. **Software specification:** Yourdon, Ward-Mellor, Hatley, Coad-Yourdon methods. Block, F-net, R-net, and Petri-net diagrams. Chen, Schlaer-Mellor for information modeling. Diagram balancing, syntax/semantics, database/diagram consistency checking. Automated database population/change propagation.
 - ii. **Software design:** Many, including Constantine, Booch/Buhr methods. Some support for database design, not fully automated.
 - iii. **Code generation:** Ada, C, C++
 - iv. **Maintenance:** Re-engineering for Ada, C++ available July '91.
8. **Documentation generation:** Fixed. 2167A via DOCGEN2167 running on PCs and Mac, own support available by end of '91.
9. **Environment Characteristics:** Multi-user and network support for UNIX version.
10. **Database:** Repository, import/export. Published interfaces and split/merge by end '91.
11. **Output formats:** ASCII, PostScript, Interleaf, HPGL, Troff, nroff, FrameMaker, WordPerfect.
12. **User interface:** Menu and mouse, windowing, color, on-line help, undo. Database browser via forms/tables component later this year.

13. **Adaptability:** Tool kit allows additions or modifications of methods, graphical notations, database schema, and user interface, including custom languages and framework support.
14. **Standards conformance:** CDIF, PCTE.
15. **Planned enhancements:**
 - i. Schema generation.
 - ii. More hardware platforms.
 - iii. User definable report formats and full support for 2167A.

Information From: John di Fernandos (503) 685-4830, May 7 1991.

Address: 17052 Jamboree Blvd., Irvine, CA 92714

Tool Summary: Graphics modeling environment with engineering analysis, planning, simulation, and real-time code generation, optimization, and automated documentation. With MATRIXxCAE for CAE/CASE integration. Formerly TekCASE.

1. **Hardware Platforms:** Apollo workstations, OSF/Motif.
2. **Products:** \$25K to \$40K for a single workstation.
 - i. CASE Station.
 - ii. CodeLink Station.
 - iii. DOC technical publishing.
3. **Tool Implementation Language:** C++
4. **Vendor Support:** Training, consultancy, support group, newsletter.
5. **Marketed Since:** 1984, Version 2.0
6. **Size of customer base:** >3k users
7. **Methodologies/functions supported:**
 - i. **Software specification:** Youron-DeMarco, Ward-Mellor, Hatley methods, with ERDs for information modeling. 70 rule-based checking facilities. Automated database pop/change.
 - ii. **Software design:** SC with prototyping and forms/screen design.
 - iii. **Code generation:** Code frames for C.
 - iv. **Testing:** Debugging, coverage and performance analysis.
 - v. **Maintenance:** Re-engineering from C.
8. **Documentation generation:** Report generation, 2167A support.
9. **Project management support:** Version management via Design Manager.
10. **Environment Characteristics:** Multi-user and network support.
11. **Database:** Use host's file system, store data in an intermediary ASCII format.
12. **Output formats:** PostScript, other.
13. **User interface:** Menu and mouse, windowing, color, on-line help.
14. **Adaptability:** Methodology tailoring (only things such as changing error messages).

LBMS/Structured Architect Workbench

Information From: (800) 333-6382

Tool Summary: Open architecture. Evolved from PSL/PSA which now provides repository facilities. Formerly marketed by Meta Systems, now bought out by LBMS.

1. **Hardware Platforms:** IBM PC
2. **Products:** SA Workbench \$6,995. Metabase Import/Export Utilities for interface between QuickSpec, SA Workbench and PSL/PSA.
3. **Tool Implementation Language:** C
4. **Vendor Support:** Hot-line, training, consultancy, newsletter.
5. **Marketed Since:** PSL/PSA since 1975, Workbench since April 1990.
6. **Size of customer base:** 300 licenses
7. **Methodologies and functions at different development stages supported:**
 - i. **Software specification:** Can accept input from QuickSpec of system specification in Microsoft Windows. SA, Ward-Mellor methods with traceability. DFDs can be created from PSL information. Information modeling. Static analysis of diagram balancing and consistency. Some resource allocation. Automatic database population, change propagation.
8. **Documentation generation:** User-definable formats, 2167A templates.
9. **Database:** Repository, bridge to PSL/PSA. Proprietary object-oriented database. Split/merge, import/export facility, published interfaces.
10. **Links to other tools:** Wordprocessing and desktop publishing systems.
11. **Output formats:** ASCII.
12. **User interface:** Menu and mouse, windowing, color, on-line help, undo. Database query facility only through reports.

LBMS/Systems Engineer

Information From: Maria Campbell (313) 663-6027

Tool Summary: Systems Engineer is a rewrite of Auto-Mate Plus. Open-architecture for desk-top based development with adherence to Dynamic Data Exchange and Object Linking and Embedding interface standards to tool extension.

1. **Hardware Platforms:** IBM PS/2, network under NETBIOS compatible LAN.
2. **Components:** System Engineer \$7,500.
 - i. SE/Open component for integration of Systems Engineer with other tools.
 - ii. Applications Engineer generates applications using input from System Engineer. Based on Jackson Technology.
 - iii. Information Manager supports integration and control of multiple System Engineer workgroup SQL databases across an organization. Also key component of LBMS REVENG.
 - iv. REVENG reverse and re-engineering toolset applies to C, COBOL, FORTRAN. Dynamic analysis capabilities based on instrumentation are being added.
 - v. Strategic Planner supports business and strategic data modeling and planning to produce a phased strategic IT plan.
 - vi. Project Engineer for project planning and estimating, extensions will include progress monitoring and an expert system to act as an advisor and validator of project plans.
 - vii. On-Line Methods based on hypertext and hypergraphics to provide support for development.
3. **Tool Implementation Language:** C
4. **Vendor Support:** Training, consultancy, hot-line, newsletter.
5. **Marketed Since:** Auto-Mate Plus first released in 1985. System Engineer since February 1990, current version 2.1S.
6. **Size of customer base:** 12,000 users in Europe and USA.
7. **Methodologies/functions supported:**
 - i. **System Specification:** Problem requirements and solutions analysis. Traceability. System structure diagrams.
 - ii. **Software Specification:** DFDs, entity life history, data modeling diagrams. Automated database population/change propagation.
 - iii. **Software Design:** Functional decomposition. Automated generation of pseudo code, knowledge-based normalization and automated logical to physical design. Screens/form design with prototyping.
 - iv. **Code Generation:** COBOL, PL/1, Ada, C.
8. **Documentation generation:** No user-definable formats, 2167A information available but not formatted.
9. **Project management support:** Security/control access, version control, project planning.
10. **Environment Characteristics:** Multi-user, network support.

LBMS/Systems Engineer

11. **Database:** Repository implemented as database.
12. **Links to other tools:** SSADM Version 4.
13. **Output formats:** PostScript, ASCII, Interleaf, HPGL.
14. **User interface:** Menu/mouse, windowing, color, on-line validation, on-line tutorial, help. Browser/query facility.
15. **Adaptability:** Free-form text/graphics and some methodology adaptability.
16. **Standards conformance:** CDIF, IRDS, AD/Cycle, Common User Access (CUA) graphical user interface.
17. **Planned enhancements:**
 - i. OS/2 Presentation Manager support and Information Manager Integration, 2nd quarter 1991.
 - ii. Improved windows based data design module, enhancements to design tools, e.g., data modeling, and full Applications Engineer Integration, 3rd quarter 1991.
 - iii. GUI painter to generate C for Windows and Presentation Manager.
 - iv. Object orientation approach.
 - v. Generation of 100% GUI application code, through enhancement of System Engineer to support C and C++.
 - vi. Matrix handling for enhanced data modeling, JSP support.

Information From: Mike Skiles (800) 872-8296

Tool Summary: Project manager workbench, requirements management and analysis system, structured analysis and design. Nastec was previously Transform Logic Corp.

1. **Hardware Platforms:** DEC VaxStation, IBM PC, AT, PS/2 and compatibles.
2. **Products:** Volume discounts available. Annual maintenance \$1056 per copy, includes technical support line, maintenance and enhancement releases. On-site training \$680 per day.
 - i. DesignAid \$6,900. Data modeling option \$1500. Real-time modules \$1500.
 - ii. AutoDraw.
 - iii. Source/Re for reverse engineering of COBOL.
 - iv. (RTrace now marketed by different company. User-definable categories and attributes. VAX-based relational database. Support VMS security features.)
3. **Tool Implementation Language:** Pascal, C.
4. **Vendor Support:** Seminars and workshops (on-site and at Nastec's Corporate Training Center), video-based training program, consultancy, support group/newsletter, hot-line.
5. **Marketed Since:** DesignAid approx 1981, AutoDraw since 1987.
6. **Size of customer base:** Information not available.
7. **Methodologies and functions at different development stages supported:**
 - i. **Software specification:** Yourdon-DeMarco, Gane-Sarson methods with real-time modeling option for Ward/Mellor and Hatley, Jackson diagrams. Resource allocation to architectural components. Timing information as annotations. Chen data modeling (optional) for information modeling. ERD rule-based validation. Syntax/semantics, diagram parent-child balancing, text/diagram consistency, model consistency checking. Automated database population, no change propagation.
 - ii. **Software design:** Warnier-Orr, N-S, process flow, HIPO, structure charts (option via AutoDraw for automatic generation), flow charts, decision tables, mini-specs. Supports normalization for database design. Validates Structured English against data dictionary.
 - iii. **Implementation:** Code generation via Transform and TELON. Forms/screen design.
 - iv. **Maintenance:** Re-engineering from COBOL.
8. **Documentation generation:** User-definable, 2167A formats.
9. **Project management support:** On-line estimation, risk assessment, management reporting, project status, review process using electronic mail, on-line task assignment, automatic status reporting, project planning and definition. Security/control access. Change reporting.
10. **Environment Characteristics:** Multi-user, remote access to database on host or LAN file server.

11. **Database:** Data dictionary implemented as database and file systems, with published interfaces and split/merge.
12. **Links to other tools:**
 - a. Nastec's Transform repository.
 - b. Desktop publishing via Pc-Paint or DEC Runoff.
 - c. DesignAid: HostLink allows access to a database and document files (graphics and text) on an IBM host computer.
 - d. PanSophic's TELON COBOL Generator.
 - e. Chen and Associates SchemaGen.
 - f. SafeSpan: DesignAid bridge to PSL/PSA.
 - g. JaDesign: support for IBM's Joint Application Design (JAD) methodology.
13. **Output formats:** Published interfaces DEC VAXDocument with Encapsulated PostScript, Interleaf TPD for VAX, Nastec's NRunoff interface for EC Runoff, Xerox Ventura Publisher and Aldus PageMaker for PCs. ASCII text files.
14. **User interface:** Menu and mouse, color, on-line help, undo facility. SQL-based access to dictionary, browser.
15. **Adaptability:** Free-form text/graphics. Keyboard macros for customized functions and utilities.

ProMod, Inc./ProMod

Information From: Marilyn Hansen (800) 255-2689, May 6 1991.

Address: 23685 Birtcher Drive, Lake Forest, CA 92630

1. **Hardware Platforms:** DEC VAX/VMS, VAXstation, IBM PC/MS-DOS, PS/2 and compatibles, Sun/UNIX, HP 9000 workstations.
2. **Products:**
 - i. ProMod/SART requirements analysis with real-time extensions. Includes ProMod/2167A report generator. PC version \$3,000, VAX ranging from \$3,500 to \$30,000.
 - ii. ProMod/TMS traceability matrix system for requirements and other development items through design \$500 to \$10,000.
 - iii. ProMod/MD object-oriented design with architectural and detailed design, PC version \$3,500, VAX ranging from microVAX \$10,000 to \$35,000. Includes ProMod/DC design charts.
 - iv. Pro/Source source code generation in Ada and C \$1,500 to \$5,000.
 - v. ProCap source code refinement and maintenance \$1,000 to \$1,500.
 - vi. ProMod/CM change and configuration control, VAX only \$500.
 - vii. Re/Source reverse engineer code to design. (Not released in USA.)
3. **Tool Implementation Language:** Converting from Pascal to C.
4. **Vendor Support:** Training and consultancy via 3rd party.
5. **Marketed Since:** In-house use since 1980, marketed in the US since 1985.
6. **Size of customer base:** 100 users, 500 licenses in USA, 10K in Germany.
7. **Methodologies/functions supported:**
 - i. **Software specification:** Yourdon-DeMarco, Hatley methods. Syntax/semantics, database/diagram consistency checking and diagram balancing. Automated database population/change propagation. Traceability.
 - ii. **Software design:** Automated transform to SC from requirements, will be able to edit this transformation in next version. OOD, Constantine methods, modular hierarchy chart, or function network chart. Language independent pseudo-code.
 - iii. **Code generation:** Ada, C, Pascal templates (control structures).
8. **Documentation generation:** Customizable formats, 2167A support.
9. **Environment Characteristics:** Database split/merge. Multi-project support.
10. **Database:** Data dictionary implemented by proprietary database, ASCII file import/export to other CASE tools.
11. **Output formats:** ASCII, PostScript.
12. **User interface:** Menu and mouse, windowing on VAX, on-line help, some undo.
13. **Planned enhancements:** Version 2 is under development, parts expected 3rd quarter '91.

Information From: John Moses (212) 571-3434, May 6, 1991.

1. **Hardware Platforms:** PC based tool runs under MS-Windows. IBM PC and compatibles under Microsoft windows.
2. **Tool Implementation Language:** C
3. **Tool Price:** \$1,395 volume discounts available. Network version \$1,545. Annual support \$250/\$340. OOD module \$495, annual support \$50.
4. **Vendor Support:** Training, consultancy, user manual includes tutorial.
5. **Marketed Since:** Since June 1988, currently Release 2.1.
6. **Size of customer base:** Over 5000 copies, approx. 7 copies per customer.
7. **Methodologies/functions supported:**
 - i. **Software specification:** Requirements extraction from natural English, potentially including user-definable attributes. Gane-Sarson, Yourdon-DeMarco, Ward-Mellor methods. Optional OOD with hardware/software allocation using Booch's architectural diagram. ERDs for information modeling. Automatic diagram leveling, balancing with syntax/semantic and database/diagram consistency checking. Traceability, also testplan tracking. Automated database population/change propagation.
 - ii. **Software design:** Structure charts, module specs automatically generated from mini specs. Also flowcharts, decomposition charts. Normalization and schema generation.
8. **Documentation generation:** User-definable reports, SQL custom reporting system, some desktop publishing features, matrix reporting facility, graphics. Have information needed for 2167A documentation but not yet produce these reports explicitly.
9. **Project management support:** Project planning, status reporting, change reporting, defect reporting.
10. **Environment Characteristics:** Network support, supporting 3Com, Novell, Token Ring, STARLAN and others under DOS. Data dictionary using dBASE III Plus format. Published interfaces, i.e., open architecture data dictionary/encyclopedia using dBASE III Plus file formats. Multi-user support. Database split/merge.
11. **Interfaces:** Import through ASCII and common delimiter published interface. Import command to populate requirements specification. Bulk in ASCII format (to populate data dictionary or requirements specifications). Export reports to dBASE III and spreadsheet.
12. **Links to other tools:** Spreadsheet also
 - i. Currently interface with IEF/IEW and Excelerator by ASCII and Common Delimiter format. In 3rd quarter '91 a standard interface to System Architect will be supported with bridges to these tools.
13. **Output formats:** ASCII, Encapsulated PostScript. Interface to desktop publishing systems.
14. **User interface:** Menu, mouse and keyboard, windowing, some use of color. Context sensitive on-line help and novice facility. Database browser/query facility through report

generation.

15. **Adaptability:** User-defined attributes test plan, on-line rules. User definable attributes for dictionary, definable attribute edit rules. User-defined attribute system (metadata) available for analysis including system variables and various system calculated metrics. User-definable diagram types using available icons.
16. **Planned enhancements:**
 - i. Code generation for C and COBOL in 4th quarter '91, Ada, C++ in 2-3rd quarter 92.
 - ii. Re-engineering beginning with COBOL in 3rd quarter '91.
 - iii. Security/control access 3rd quarter '91.
 - iv. OS/2 and AIX (RISC) version.
 - v. Rapid prototyping support 4th quarter '91 for COBOL and C.
 - vi. SQL server interface.
 - vii. Methodology extensions for Constantine's object-oriented notation and Coad/Yourdon design editor for checking diagram consistency.
 - viii. Support for C++.
 - ix. Forms/screen design 3rd quarter '91, with prototyping in COBOL.
17. **Collaboration with other organizations:** Tool assistance program with IBM. Will conform to IBM's repository formats. Support of IBM AD/Cycle 1st quarter 92.

Information From: Bjorn Hemdal (301) 731-3600

Tool Summary: Methodology independent with isomorphic, interchangeable graphic and text forms.

1. **Hardware Platforms:** Sun, DEC VAXstation, Apollo workstations, VAX systems via conventional terminals, Atari PCs.
2. **Components:**
 - i. Auto-G comprised of graphic editor and underlying database.
 - ii. Sema semantic analyzer or diagnostic facility.
 - iii. Sadmt translator from specification language to SADMT.
 - iv. Dbutil design file manager.
 - v. T-print for translating graphical to textual representation.
 - vi. T-parse for translating textual to graphical representation.
 - vii. Special utility programs, such as plot generators.
3. **Tool Implementation Language:** Currently C, planning Ada or C++ for next version.
4. **Tool Price:** \$31,500 for 1st license.
5. **Vendor Support:** Training, consultancy, hot-line. Support group in UK, USA as needed.
6. **Marketed Since:** 1987 in Europe, 1989 in USA.
7. **Size of customer base:** 25 active users in Europe.
8. **Methodologies/functions supported:**
 - i. **Specification:** Single formal notation that can be checked for correctness, completeness, and consistency. No explicit resource allocation. Capture of complete logical behavior and performance aspects. Concurrency, replication, timing. No traceability. Automated database population/change propagation.
 - ii. **Code generation:** Ada, SADMT, C.
9. **Document Generation:** Fixed formats.
10. **Project management support:** Configuration management, but relies on operating system support for file access and time-date stamping. Extensive versioning and view capabilities.
11. **Environment Characteristics:** Multi-user, network support.
12. **Database:** Data dictionary implemented as flat file system (looking at object-oriented database for next version). Import/export as ASCII coded, T language statements.
13. **Output formats:** Primarily plotting. ASCII, PostScript.
14. **User interface:** Menu and mouse, windowing (in Sun, DEC, HP environments), some on-line help, undo. Query facility for locating instances on G diagrams. Data items or structure definitions dumped to file for external processing.
15. **Planned enhancements:**
 - i. 2167 report generation, perhaps user-definable formats.

RJO Enterprises/Auto-G

- ii. Datadic data dictionary program to provide selective data dictionary query facility.
- iii. AI-based help facility.
- iv. Generation of C++ (perhaps in 4th quarter 1991).
- v. In next version, due 3rd quarter 1991, simulation and test harness capability.

Reasoning Systems/REFINE

Information From: Gordon Kotik (415) 494-6201, May 20 1991.
Wants a copy, FAX (415) 494-8053.

Tool Summary: Software Refinery is an interactive knowledge-based programming environment to prototype complex applications using a high-level, rule-based, executable specification language, synthesize LISP code, customize to create knowledge-based environments tailored for specification of application areas, reuse knowledge in the form of rules and logic formulas.

1. **Hardware Platforms:** Sun/SunOS, Symbolics, HP, TI Explorer and MicroExplorer workstations. X-Windows, GNU Emacs.
2. **Components:** REFINe license from \$9,900 for Sun to \$12,900 for Symbolics, volume discounts available. Annual maintenance contracts \$900, preferred customer maintenance \$3,400, university maintenance \$500. Training \$2,500 for first 4 at Reasoning Systems, \$8,000 on-site.
 - i. High-level, wide-spectrum executable specification language with compiler to transform specification into Common LISP, syntax system to integrate REFINe with existing computer languages and to create new languages and debugging system for monitoring execution of REFINe programs and creating customized debugging tools.
 - ii. Knowledge base of objects including programs, logical assertions, and documents, allows user-definable object types.
 - iii. C Language Subsystem reverse engineering \$1,900 to \$2,600.
 - iv. Ada/RevEng a REFINe application currently handling 50% Ada language syntax, producing abstract syntax trees, structure charts, hypertext-style Ada source code inspector.
 - v. RERUN: REFINe runtime environment to execute refinery application. >From \$2,500 for Sun to \$3,200 for Symbolics.
 - vi. RECAST: platform on which to build C applications, includes knowledge-based representations for C programs. For development of communication systems with network modeling, reconfiguration, and simulation with automated generation of conformance tests via OSI guidelines. Interactive graphics development using state machine diagrams. \$1,900 to \$2,600.
 - vii. INTERVISTA toolkit for building graphical user interfaces under X Windows.
 - viii. User Interface Toolkit for creating interactive graphics tools used to graph (re-engineer) C, COBOL, JCL software.
 - ix. DIALECT generates program language parsers and printers from grammars. Has been used for Ada, C, and others.
3. **Tool Implementation Language:** REFINe (moving to C++, 1992).
4. **Vendor Support:** Training, maintenance, consultancy, newsletter, hot-line.
5. **Marketed Since:** July 1985
6. **Size of customer base:** Over 100 licenses.
7. **Methodologies and functions at different development stages supported:**
 - i. **Software specification:** Object-oriented diagrams and DFDs. No concurrency,

replication, timing information, or resource allocation. Information modeling using object-oriented approach. Traceability. Syntax validation, checking for dead code. Executable specification language with assertions, supports checking for communication protocols deadlock, livelock, unreachable and unused states.

- ii. **Code generation:** Common LISP code, Ada, C, FORTRAN. Forms/screen design.
 - iii. **Testing:** static analysis tools for C.
 - iv. **Maintenance:** Re-engineering for Ada, C, FORTRAN.
- 8. **Documentation generation:** User-definable formats.
 - 9. **Project management support:** Configuration management.
 - 10. **Environment Characteristics:** Knowledge base restoration to previous state saving, and sharing. No multi-user support, but network support.
 - 11. **Database:** Repository implemented as database, with import/export, published interfaces. Support for generation/analysis of competing designs, save/restore knowledge based, sharing of knowledge base (no merging). Editor and file system interface based on EMACS text editor.
 - 12. **Output formats:** PostScript.
 - 13. **User interface:** Menu/mouse, windows, color, textual specification, menu-based knowledge-base browser and editor, on-line help. On-line documentation with browser, keyword search capability, and on-line index.
 - 14. **Adaptability:** Knowledge base allows user-definable object types. General purpose object-oriented database, and syntactical transformation tools to adapt meaning of icons. General purpose graphics editor. Ability to create, say, natural language query language, object schema for storing decisions and reasons. Static analysis capabilities can be created in terms of rules and patterns. Free-form text/graphics.
 - 15. **Planned enhancements:**
 - i. C++ analyzers by end of '91.
 - ii. CDIF and X-Windows conformance.
 - iii. Translation of StP data, structure charts, and Petri-nets into REFINE and hence code generation.

Information From: Wayne Hansley (919) 881-2144, May 1991.

Tool Summary: Design specification, modeling, and simulation tool for both hardware/software systems. Interfaces to popular CASE tools for performance analysis. Can embed C code to be executed, workbench supports all C data types and storage classes. Formerly PAWS.

1. **Hardware Platforms:** Sun/UNIX, HP/Apollo, DEC VAXstation workstations.
2. **Components:** Basic workstation version \$36,000.
 - i. SES/design for graphical construction of system designs, behavior specified in C.
 - ii. SES/sim translates a design specification into an executable simulation model, the simulation language is an object-oriented superset of C and C++.
 - iii. SES/scope animation modules for observing and debugging an executing simulation model.
 - iv. SES/graph.
3. **Tool Implementation Language:** C, moving to C++.
4. **Vendor Support:** Training, consultancy, hot-line, support group and newsletter.
5. **Marketed Since:** PAWS/GPSM introduced late 1970's. SES/workbench marketed since March 89. Currently version 2.0, 2.1 due out summer '91.
6. **Size of customer base:** Installed in over 100 locations worldwide.
7. **System specification:** Object-oriented approach using directed graphs, block diagrams, DFDs (Ward-Mellor or Hatley) and flow charts for specification. Supports object types, methods, instances, references and type inheritance. Objects can have multiple dimensions and can be referred to by pointers. Hardware/software allocation. Capture of timing/behavioral information via annotations on diagrams, used in simulation. Transaction-oriented, discrete event simulation, automatically generated from system design, for performance analysis. Can attach assertions for checking design correctness. Traceability. Forms/screen design.
8. **Documentation generation:** Statistical reports generated by user-specifiable forms.
9. **Project management support:** Configuration management.
10. **Environment Characteristics:** Multi-user, network support.
11. **Database:** No underlying database.
12. **Links to other tools:** IDE's StP.
13. **Output formats:** PostScript.
14. **User interface:** Menu/mouse, windows, hypertext-like on-line help, on-line reference manual, undo.
15. **Planned enhancements:**
 - i. Ports to other machines underway.
 - ii. Summer '91 version will include enhanced debugging, color, graphical output.

- iii. Ada, C++ supported '92.
- iv. VHDL ASCII standard.

SPS, Inc./Classic Ada

Information From: Lois Valley (407) 984-3370

Tool Summary: Back end CASE tool.

1. **Hardware Platforms:** VAX/VMS, Sun/UNIX, Apollo and others UNIX-based systems. X-Windows.
2. **Products:**
 - i. Classic-Ada Toolset \$2,000, with Persistence Toolset \$3,000.
 - ii. Classic-Works interactive browsing capability \$500.
 - iii. ClassLook set of class reusable libraries to inherit capability to create X-Window environments \$1,000.
3. **Tool Implementation Language:** Ada
4. **Vendor Support:** Training, consultancy, bulletin board.
5. **Marketed Since:** 2 years
6. **Size of customer base:** > 50 sites.
7. **Methodologies and functions at different development stages supported:**
 - i. **Software design:** OOD methods with automated database population/change propagation.
 - ii. **Code generation:** Ada.
 - iii. **Testing:** Syntax and semantic Classic-Ada and Ada analysis. Automatic message tracing for debugging and performance analysis.
8. **Environment Characteristics:** Multi-user and network support.
9. **Database:** Data dictionary implemented as open database.
10. **User interface:** Command line with on-line help.

SPS/EPOS

Information From: Steven (212) 686-3790, May 8 1991.

Address: 14 E. 38th Street, 14th Floor, NY 10016

Tool Summary: For real-time, process control systems. Language-independent. Code translation for Fortran. Reuse of knowledge, design information, and planning details.

1. **Hardware Platforms:** Sun, Apollo, HP, DEC workstations, VAX/VMS, IBM-PC/AT/MS-DOS, Intel/iRMX, Siemens. Planned AT&T/MS-DOS, Motoral/UNIX, Data General MV series/AOS/VS.
2. **Components:** \$14,785 up to \$100,000 for
 - i. EPOS Code Generation Tool System. Currently Pascal, FORTRAN, Ada, PEARL.
 - ii. EPOS-R for requirements specification
 - iii. EPOS-S specification language and design system for system design specification using stepwise refinement. Combines graphics with PDL.
 - iv. EPOS-P project specification e.g., project structure, work structure, work packages, project schedules.
 - v. EPOS-A Analysis Support Package for consistency/completeness, interface, lack of ambiguity checking.
 - vi. EPOS-M Management Support Package for project control, cm, progress reporting.
 - vii. EPOS-D Documentation Package for automated documentation generation.
 - viii. EPOS-C Communication System for user-friendly communication command system with interactive editing.
 - ix. RE-SPEC reverse engineering for EPOS design specifications, from Pascal, FORTRAN.
3. **Tool Implementation Language:** Proprietary.
4. **Vendor Support:** Training, consultancy, support group, quarterly newsletter.
5. **Marketed Since:** 1984 in the USA, early 1980's in Europe.
6. **Size of customer base:** 500 copies in USA.
7. **Methodologies/functions supported:**
 - i. **System specification:** System design using hardware blocks, module connection. Traceability. Syntax, completeness/consistency checking. Simulation.
 - ii. **Software specification:** Ward-Mellor, Hatley methods with data/control flows, data structure, Petri-nets. Some capture of timing/behavioral information. Jackson diagrams for information modeling. Syntax/semantics and consistency checking. Prototyping for screens only. Automated database population/change propagation.
 - iii. **Software design:** Function, event, module, data flow/structure, and device oriented diagrams. Consistency checking between diagrams and spec, between Ada programs and specs.
 - iv. **Code generation:** C, 70-85% of Fortran, Pascal, 60-70% Ada code for concurrent systems.

SPS/EPOS

8. **Documentation generation:** User-definable formats, with 2167A support.
9. **Project management support:** Project planning/scheduling with automated report generation in text/graphics. Project structure diagram, PERT and Gantt charts, current progress diagrams, work breakdown plans, network diagram, milestones. Status and change reporting. Configuration management.
10. **Environment Characteristics:** Some multi-user support.
11. **Database:** Proprietary with import/export in ASCII. Split/merge.
12. **Links to other tools:** Graphic input with CORE graphics editor, GOSS, Perspec?
13. **Output formats:** ASCII, PostScript.
14. **User interface:** Menu and mouse, windowing (on VAX under X, Sun/UNIX, and HP9000), on-line help. Database query.
15. **Planned enhancements:**
 - i. Porting to PCs, Macintosh, IBM PS/2 OS/2. Porting to MS Windows for PC, available '92.
 - ii. RE-SPEC for COBOL, C, Ada.
 - iii. Configuration management.

Scandura Intelligent Systems/re/NuSys Workbench

Information From: Jean Baker (215) 664-1207, 17 May 1991.

Address: 1249 Greentree Lane, Narberth, PA 19072

1. **Hardware Platforms:** IBM PC, SUN Sparc, RS6000 under X-Windows.
2. **Components:** re/NuSys Workbench from \$2,800 to \$12,600. Components can be purchased individually.
 - i. ScanFlow Designer \$995.
 - ii. Simulator for debugging and visual test coverage \$2,800.
 - iii. Program Generator for Ada, Pascal, C, COBOL, FORTRAN \$3,600.
 - iv. Implementor \$2,800.
3. **Tool Implementation Language:** C
4. **Vendor Support:** Training, consultancy.
5. **Marketed Since:** 1989
6. **Size of customer base:** 100 licenses
7. **Methodologies and functions at different development stages supported:**
 - i. **Software specification:** Flowform diagrams. Also used to support information modeling. Hardware/software allocation. Consistency checking.
 - ii. **Software design:** Pseudocode with checking options for C, COBOL, FORTRAN, Pascal, Ada. Screen prototyping.
 - iii. **Code generation:** Ada, C, Pascal, FORTRAN, COBOL. C++ in September 1991.
 - iv. **Maintenance:** Re-engineering for Ada, FORTRAN, Pascal, COBOL. C++ after September.
8. **Documentation generation:** For printing hardcopy. User-definable formats. 2167A information available but not templates.
9. **Project management support:** Use a component approach that supports team working. No central repository, information stored in flowforms.
10. **Environment Characteristics:** Network support.
11. **Output formats:** ASCII.
12. **User interface:** Command line, and menu, windowing, on-line help, some undo.
13. **Adaptability:** Via 4GL to create high level languages.
14. **Planned enhancements:** Working with other vendors to provide links to repositories/libraries.

Semaphore Tools/Pilot

Information From: Ted Cannie (508) 794-3366, May 14 1991.

Tool Summary: Full life cycle support using object-oriented approaches, with open architecture and repository. Due for release in September '91.

1. **Hardware Platforms:** IBM PCs under MS-Windows, and Sun/UNIX under X-Windows.
2. **Products:** PC version \$5,000, Unix \$5,500.
3. **Tool Implementation Language:** C++
4. **Vendor Support:** Training, consultancy, newsletter.
5. **Marketed Since:** Prerelease versions will be made available to selected sites.
6. **Size of customer base:** Not applicable.
7. **Methodologies and functions at different development stages supported:**
 - i. **Software specification:** Single diagram type supporting OOA/OOD using Booch, Coad/Yourdon, and Semaphore OO Notation. Also supports ER. Diagrams can be annotated with text. Completeness/consistency checking of database. Automated database population/change propagation.
 - ii. **Code generation:** C++.
 - iii. **Maintenance:** Re-engineering for C++.
8. **Documentation generation:** Via SQL interface to repository.
9. **Project management support:** Security/control access, configuration management, version control.
10. **Database:** Object-oriented repository with access via SQL interface. Split and merge.
11. **Output formats:** ASCII.
12. **User interface:** Menu and mouse, windowing.
13. **Adaptability:** Methodology tailoring via user-defined rules for completeness/consistency checking of a model. Future versions will incorporate inferencing techniques based on forward and backward chaining and pattern matching. Allow adding entities and attributes to the repository.
14. **Planned enhancements:**
 - i. Multi-user, version 2 planned for 1st quarter 1992.
 - ii. Code generation and reverse engineering of additional languages, likely Ada.
 - iii. Timing diagrams for explicit capture of timing information.
 - iv. Animation of specification.
 - v. Schema generation for database design and forms/screen design.
 - vi. Explicit support for 2167A documentation.
 - vii. Interface to text publishing systems such as Interleaf.
15. **Collaboration with other Organizations:** Potentially with Saber-C.

Semaphore Tools/Pilot

Information From: Dan, Ernie Moore (415) 957-9175, May 10 1991.

Tool Summary: Graphical modeling tools, support for multiple methodologies, distributed intelligence, open architecture. Object-oriented, distributed, repository-based CASE.

1. **Hardware Platforms:** Maestro II Workstation (MVS). MS-DOS with own windowing manager and multi-tasking software. IBM PC/PS/2 compatibles with workstation connected to UNIX-based file server on DEC VAX or Philips machines through Ethernet.
2. **Components:** Tool price for single user \$13,000.
 - i. Object Management System (OMS) provides meta model, allows customizing data model, or integrating SoftLab and 3rd party tools. Data associated with software development process is stored in a repository organized by OMS. It provides access rights, versions and variants, distributed data storage and access, elementary and user-defined transactions. Processor and geographical distribution, with copy of data model on all servers.
 - ii. MGEN application generator expected second half '90.
 - iii. DDT Diagram Design Tool.
 - iv. LDT Layout Design Tool.
 - v. GED Graphics Editor.
 - vi. TEXT Text Editor.
 - vii. CMS Configuration Management System.
 - viii. PMS Project Management System.
 - ix. COMM Communication Packages.
3. **Tool Implementation Language:** PROLAN, C-like.
4. **Vendor Support:** Training, consultancy, newsletter.
5. **Marketed Since:** Maestro I introduced in 1978. Maestro II marketed since autumn 1989 in Europe, January 1990 in USA.
6. **Size of customer base:** 23,000 Maestro I workstations worldwide.
7. **Methodologies/functions supported:**
 - i. **Software specification:** SA, LSDM, SSADM methods. Merise for information modeling. Automated database population/change propagation. Capture of timing/behavioral information? Traceability?
 - ii. **Software design:** SD method. Schema generation for database design.
 - iii. **Code generation:** Either by 2-way interface with generators via the data dictionary, or by knowledge-based generators that produce logic and control code, screen definitions, database definitions and schema. Uses generator engine with spec based and knowledge base parts. Currently have knowledge base support for IBM DB2, COBOL, working with HP for HP9000 and others with C.
8. **Documentation generation:** User-definable formats? 2167A support?
9. **Project management support:** Own text editor/word processor, office automation software (electronic mail, diary, etc.), Workbreakdown structure. coordination and communication.

Workbreakdown structure. Configuration management, versioning, audit trail, change rollback, change reporting, defect reporting, security/control access.

10. **Environment Characteristics:** Multi-user support, network (heterogeneous) support via LAN, Ethernet.
11. **Database:** Server-based object-oriented repository, C interface. Database split/merge.
12. **Links to other tools:**
 - i. Communication packages to link Maestro II to variety of common machines including IBM, Siemens, DEC VAX, Bull, ICL, and any UNIX computer.
 - ii. Interfaces to IEW, and Micro Focus COBOL.
 - iii. Trimarand, Inc. code generator METAgen in PC/LAN environment, knowledge-based generator embedded in Maestro II. Expect release mid 90.
 - iv. Aeon for requirements extraction from natural English.
13. **Output formats:** Postscript. Essentially all UNIX file system devices.
14. **User interface:** Menu and mouse, windowing, on-line help (hypertext). Database browser/query facility.
15. **Adaptability:** Designed to be fully extensible and customizable. Programmable user-interface. Modifiable graphic notation for diagrams.
16. **Standards conformance:** IRDS, AD/Cycle.
17. **Planned enhancements:**
 - i. UNIX, OS/2 based workstations, HP and IBM hardware.
 - ii. Object editor, inheritance, and more object facilities such as functions, subtyping.
 - iii. Object-oriented query language.
 - iv. Additional DBMS interfaces, including DB2, Predict.
 - v. Check-in/-out capabilities.
18. **Collaboration with other organizations:** IBM with AD/Cycle.

Software Systems Design, Inc./AISLE family

Information From: Thomas Radi (714) 625-6147

Address: 3627 Padua Avenue, Claremont CA 91711

Tool Summary: Set of tools to take real-time structured analysis input and support design and testing. C version (CISLE) available.

1. **Hardware Platforms:** VAX and MicroVAX, Sun, DEC, Apollo workstations, PCs, others.
2. **Components:**
 - i. ADADL Ada-based PDL, \$5,000 to \$18,800.
 - ii. DocGen document generator for MIL-STD documentation \$4,600 to \$17,000.
 - iii. TestGen Ada design and code testing tool \$4,600 to \$17,000s
 - iv. GrafGen graphical Ada design system \$7,000 to \$10,500.
 - v. ASE Ada/ADADL syntax directed editor \$1,390 to \$7,800.
 - vi. ARIS Ada/ADADL RTSA requirements interface system interfaces with Teamwork to create first cut at an Ada program structure working from DFDs, \$7,500 to \$14,500.
 - vii. AIEM on-line debugging and analysis tools \$5,200 to \$15,200.
 - viii. QualGen quality metrics \$4,600 to \$17,000.
 - ix. RETT requirements traceability \$4,600 to \$17,000.
3. **Tool Implementation Language:**
4. **Vendor Support:** Training, consultancy, support group meetings at Tri Ada.
5. **Marketed Since:** 1985
6. **Size of customer base:** 46 organizations
7. **Methodologies and functions at different development stages supported:**
 - i. **Software design:** Input from RTSA database compatible with Teamwork, Excelerator, StP, Structured Architect. Produces OOD Booch/Buhr-like diagrams, uses templates for documentation and pseudo-code design. Provides structure charts, quality and complexity analysis. Forward and backward traceability from requirements to design, code, and tests. Automated database population/change propagation.
 - ii. **Code generation:** Ada
 - iii. **Testing:** Design review expert assistant, unit test strategy generator, test effort estimator, test coverage analyzer.
 - iv. **Maintenance:** Re-engineering of Ada.
8. **Documentation generation:** User-definable formats and 2167A support.
9. **Project management support:** Project planning, status reporting, Security/control access.
10. **Environment Characteristics:** Multi-user, network support.
11. **Database:** Data dictionary implemented as database.

Software Systems Design, Inc./AISLE family

12. **Links to other tools:** Teamwork, Excelerator, StP, Structured Architect.
13. **Output formats:** Compatible with Interleaf, RUNOFF, nroff/troff and other word processors.
14. **User interface:** Text based. Database browser/query facility.
15. **Adaptability:** User-expandable interfaces to the database.

Information From: Chuck Williams (301) 224-3710

Tool Summary: The Virtual Software Factory (VSF) is a meta-CASE tool. Intended to support integration at the information level rather than the tool level. Addresses method and design database integration. Providing for verifiability, traceability, and tailorability across the life cycle. Available instances: HOOD-SF and SSADM-SF. Other methods implemented by Systematica and VSF users include CORE requirement capture method, and Mascot3/Ada (British MOD standard for real-time systems development).

Supports meta-modeling constructs such as multiple inheritance across hierarchies, multiple design databases, automatic translation between methodologies, and specification and enforcement of rules for methodologies. Schemas can be described using the VSF formalisms. Engineer specifies: (1) required documentation, say 2167, via MWB; (2) traceability model between design objects or earlier/later project phases; (3) filter mechanism to implement checking rules for static diagnostics, underlying formalism is a decidable second-order logic. VSF comes with a high-level, internal logic specification language resembling PROLOG, supports beliefs, belief generation rules, pre/post-conditions, etc. No simulation. Built-in file manager, design databases created by VSF are stored in a VSF specific-format. Documents stored/retrieved using a hypertext approach. Design fragments can be conserved to another tool whose output can then be merged (with conflict checking) back into the workbench. Host environment is a shell around VSF, user uses the configuration and project management tools available in the host environment. Not multi-user. Does merge design information into a central database via VSF merge facility.

1. **Hardware Platforms:** Sun, DECstation workstations, IBM PS/2 under OS/2, IBM RS6000, VAXstation.
2. **Components:** \$200,000, Systematica are also paid a percentage of licence fee from CASE tools developed with VSF.
 - i. **Methods Engineering Workbench (VSF/MWB).** Primarily textually-oriented to define graphics environment for the workbench. Used to define methodologies and configure the design environment.
 - ii. **Analyst Workbench (VSF/AWB).** Graphical and textual editors that were predefined for methodologies in the MWB.
3. **Tool Implementation Language:** Ada, approx. 300,000 lines of source code.
4. **Vendor Support:** Training, Consultancy.
5. **Marketed Since:** March 88.
6. **Size of customer base:** 60-70 in Europe.

7. **Planned enhancements:** Version for IBM PS/2.

8. **Collaboration with other organizations:**

- i. DEC.
- ii. COGNOS, Inc.
- iii. Focus.
- iv. IBM for AD/Cycle.

Information From: 44 202 297292

Tool Summary: Instantiation of VSF/AWB.

1. **Hardware Platforms:** Sun, DECstation workstations, IBM PS/2 under OS/2, IBM RS6000, VAXstation.
2. **Product:** 7,000 pounds
3. **Tool Implementation Language:** Ada.
4. **Vendor Support:** Training, Consultancy.
5. **Marketed Since:** 1988 in Europe, just starting in USA.
6. **Methodologies/functions supported:**
 - i. **Software Specification:** DFDs, DSDs for information modeling, entity life history diagrams. On-line validation of user actions. Consistency and completeness checking with diagram/database consistency checking.
 - ii. **Design:** Dialogue design. Database design through 3rd normal form.
 - iii. **Code Generation:** Some.
7. **Documentation generation:** User definable formats only achievable through tailoring using the methodology workbench. 2167A information present but not formatted.
8. **Project management support:** QA support, problem reporting.
9. **Environment Characteristics:** Multi-user, network support.
10. **Database:** Central repository implemented as IKBS, separate partial knowledge bases on workstations can be implemented as database or by file systems as appropriate for environment.
11. **Output formats:** ASCII, PostScript, interface to desktop publishing systems.
12. **User interface:** Menu, mouse, windowing. Navigation.
On-line help/undo facility?
13. **Adaptability:** Methodology tailoring via VSF.
14. **Standards conformance:** SSADM British government standard for EDP system development.
15. **Planned enhancements:** 2167A documentation support.

Systematica Ltd./HOOD-SF

Information From: Chuck Williams (301) 224-3710

Tool Summary: Instantiation of VSF/AWB.

1. **Hardware Platforms:** Sun, DECstation workstations, IBM PS/2 under OS/2, IBM RS6000, VAXstation.
2. **Product:** 7,000 pounds sterling, \$17,000.
3. **Tool Implementation Language:** Ada.
4. **Vendor Support:** Training, Consultancy.
5. **Marketed Since:** 1988 in Europe, just established USA affiliate.
6. **Size of customer base:** None in USA.
7. **Methodologies/functions supported:**
 - i. **Software Specification:** Object-oriented methods.
 - ii. **Design:** Ada PDL.
 - iii. **Code Generation:** Ada.
8. **Documentation generation:** User definable formats only through tailoring with the methodology workbench. 2167A information available but not formats.
9. **Environment Characteristics:** Multiple projects supported. Multi-user, network support.
10. **Database:** Split, merge.
11. **Output formats:** ASCII, PostScript, HPGL, interface to desktop publishing systems.
12. **User interface:** Mouse, windowing, on-line help. Browser.
13. **Adaptability:** Methodology tailoring via VSF.
14. **Standards conformance:** HOOD defacto standard for European aerospace Ada development.
15. **Planned enhancements:** 2167A documentation support.

Information From: Jan Smedley (205) 837-2400

1. **Hardware Platforms:** Sun, VAX
2. **Tool Implementation Language:** Ada
3. **Tool Price:** Free
4. **Vendor Support:** Training, newsletter, consultancy, hot-line.
5. **Marketed Since:** Available since 1987.
6. **Size of customer base:** >200 installations
7. **Methodologies and functions at different development stages supported:**
 - a. **System specification:** F-net, IDEF diagrams. Hardware/software allocation. Simulation. Traceability. Automated database population. Capture of timing information?
 - b. **Software specification:** Various diagrams.
 - c. **Software design:** Various diagrams.
 - d. **Code generation:** Ada
8. **Documentation generation:** User-definable formats, 2167A templates.
9. **Project management support:** Configuration management, status reporting, change reporting.
10. **Environment Characteristics:** Network support.
11. **Database:** Repository implemented as ERA database. Split/merge, import/export.
12. **Links to other tools:**
13. **Output formats:** ASCII for 2167A documentation, PostScript for graphs.
14. **User interface:** Menu and mouse, windowing, color, on-line help, some undo. Database browser/query facility.
15. **Adaptability:** Free-form text/graphics. Some methodology tailoring.
16. **Planned enhancements:**
 - i. Multi-user support.
 - ii. X-Windows.
 - iii. Potentially OOD support.

Information From: Cathy Chou (703) 352-8500, May 10 1991.

Tool Summary: For definition, analysis, and simulation of system designs based on Engineering Block Diagrams.

1. **Hardware Platforms:** Apollo/Aegis, Sun/UNIX, Dec VAXstation/Ultrix workstations. IBM PS/2.
2. **Products:**
 - i. TAGS \$6,500. Includes:
 - a. Input/Output Requirements Language (IORL),
 - b. Diagnostic Analyzer (DA),
 - c. Automated Configuration Management (CM),
 - d. Simulation System with simulation compiler and Executable Ada Code Generator (ECG) are no longer marketed.
 - ii. Requirements Validation Tool Suite (RVTS). Currently on IBM PC compatibles under DOS being ported to X-Windows and Ultrix. Requirements stored in a relational database. Supports automatic extraction of natural language-based requirements statement and their cataloging into a hierarchical database for sorting, analysis, tracing, design mapping, and report generation. Multi-user network environment with centralized database manager. Output formats: ASCII text files. User interface: menus. Requirements Tracer (RT) second generation RVTS, marketed since: December 1990. \$12,500 for 1st seat, \$6,500 thereafter.
3. **Tool Implementation Language:** C
4. **Vendor Support:** Training, consultancy, forming support group, newsletter.
5. **Marketed Since:** TAGS since 1984.
6. **Size of customer base:** In the hundreds.
7. **Methodologies/functions supported:**
 - i. **System specification:** Functional decomposition with object-oriented. RT can import an ASCII text file and extract requirements from this. With traceability and resource allocation.
 - ii. **Software specification:** Own methods. Capture of timing/behavioral information. No information modeling. Syntax/semantics, diagram balancing, database/diagram consistency checking.
 - iii. **Software design:** Control flow diagrams.
 - iv. **Code generation:** No longer marketed.
8. **Documentation generation:** Not in TAGS, with user-definable formats in RT. 2167A support via other documentation tools.
9. **Project management support:** Configuration management, change reporting, version identification, time stamping. Security/control access, some status reporting, defect reporting.

Teledyne Brown Engineering/TAGS/RT

10. **Environment Characteristics:** Multi-user and network support.
11. **Database:** Central. RT import/export in ASCII, TAGS uses library routines accessed with user-defined C and FORTRAN programs. No database split/merge. Data dictionary has no textual descriptions.
12. **Links to other tools:** Interleaf and Mentor Graphic's Context publishing software.
13. **Output formats:** PostScript, Interleaf for 2167A.
14. **User interface:** Menu/mouse, windowing, on-line help, some undo. Database browser/query facility,
15. **Planned enhancements:** Port to IBM's AIX operating system.

Information From: Dick Taylor (703) 849-1481.

Tool Summary: For planning, analysis, design, construction, and maintenance.

1. **Hardware Platforms:** PC, workstation for development, mainframe for code generation.
2. **Products:** Price?
3. **Tool Implementation Language:** C++
4. **Vendor Support:** Training, consultancy, hot-line, bulletin board.
5. **Marketed Since:** 1986
6. **Size of customer base:** Over 350 users.
7. **Methodologies/functions supported:**
 - i. **Software specification:** DFDs, ERs, action diagrams. Automated database population/change propagation.
 - ii. **Software design:** SCs, screen/forms design.
 - iii. **Code generation:** Code and screen generation. Schema generation.
 - iv. **Testing:** COBOL generation for testing based on diagrams.
 - v. **Maintenance:**
8. **Documentation generation:**
9. **Project management support:** Security/control access, history tracking, version control.
10. **Environment Characteristics:** Multi-user and network support.
11. **Database:** Encyclopedia implemented as object-oriented database. Check-in, check-out, split/merge, import/export facility.
12. **Output formats:**
13. **User Interface:** Menu/mouse, windowing, color.
14. **Planned enhancements:**
 - i. CUI compliance on SAA platforms.
 - ii. New diagram facilities.
 - iii. Reverse engineering.
 - iv. Automated first cut at design.
15. **Compatibility:** With Ad/Cycle.

Verilog/AGE

Information From: Mark Luciw (301) 220-2430, May 10 1991.

1. **Hardware Platforms:** HP 9000, HP/Apollo, Sun, VaxStations. UNIX and X-Windows.
2. **Products:**
 - i. AGE \$50,000 for single-user, volume discounts available. Includes:
 - a. ASA for requirements analysis and system validation, includes ASA-ED editing tool, ASA-PM modeling, ASA-PG test generation.
 - b. GEODE for designing and code generation, includes GEODE-ED editor, GEODE-SM simulator, GEODE-RT run time generator.
 - c. MCAG linking module for traceability.
 - ii. Logiscope for software quality analysis.
3. **Tool Implementation Language:** Pascal, C
4. **Vendor Support:** Training, consultancy, newsletter.
5. **Marketed Since:** 1990 (as AGE), ASA and GEODE for 3 to 4 years.
6. **Size of customer base:** Over 1000 copies.
7. **Methodologies/functions supported:**
 - i. **System specification:** SADT/IDEF method with resource allocation and some capture of timing information. Consistency, functional decomposition checks. Simulation. Traceability.
 - ii. **Software specification:** SADT Datagrams for information modeling. Automated database population/change propagation.
 - iii. **Software design:** SDL notation.
 - iv. **Code generation:** C.
 - v. **Testing:** See Logiscope.
 - vi. **Maintenance:** See Logiscope.
8. **Documentation generation:** User-definable formats.
9. **Project management support:** Some security/control access, change reporting via tracing facility.
10. **Environment Characteristics:** Multi-user, network, multi-project support.
11. **Database:** Data dictionary as part of ASA, implemented as file system. All information maintained in ASCII files. Import/export facility, split/merge.
12. **Output formats:** PostScript. Interface to Interleaf and FrameMaker.
13. **User interface:** Menu and mouse, windowing, some color, on-line help, some undo. Database browser/query facility,
14. **Standards conformance:** SDL/CCITT, X Windows.
15. **Planned enhancements:**
 - i. Generation of Ada code by June '91.

Verilog/AGE

- ii. Object-oriented support through LOVE programming support environment, will be made available as part of AGE and will generate C++.
- iii. Tie in user-interface toolkits.

Information From: (617) 890-2273, May 21 1991.

1. **Hardware Platforms:** IBM PC
2. **Products:**
 - i. Professional \$2,795, or with prototyper \$3,395.
 - ii. LAN Professional (3 nodes) \$7,895.
3. **Tool Implementation Language:** Mainly C.
4. **Vendor Support:** Training, consultancy, newsletter.
5. **Marketed Since:** 1985.
6. **Size of customer base:** >8000 users, >3000 installations.
7. **Methodologies and functions at different development stages supported:**
 - i. **Software specification:** Yourdon-DeMarco, Gane-Sarson methods. Chen, ER diagrams for information modeling. Diagram balancing, consistency checking (diagrams are validated as created). Automatically populated database and change propagation.
 - ii. **Software design:** Yourdon-Constantine, Page-Jones methods with automatic generation from specification and design complexity measurement. SQL generation for database design. Screen prototyping.
8. **Documentation generation:** Fixed document types, some contents can be customized. 2167A information available but not formatted.
9. **Project management support:** Security/control access.
10. **Environment Characteristics:** Multi-user and network support. Multi-project.
11. **Database:** Server-based repository implemented as file system and database with published interfaces. Split/merge.
12. **Output formats:** PostScript, tiff, ASCII, other.
13. **User interface:** Menu and mouse, windowing, on-line help, undo facility. Database browser/query facility.
14. **Planned enhancements:**
 - i. Scheme extraction from database.
 - ii. Code generation for C and COBOL later in '91.

Information From: David Stephenson (703) 758-1501

Address: 1501 Broadway, New York, NY 10035

Tool Summary: Primarily for business software.

1. **Hardware Platforms:** IBM PC-AT, PS/2 and compatibles, DOS.
2. **Components:** Tool price \$1,995 single user. User Interface Generator option for screen prototyping and code generation no longer marketed.
3. **Tool Implementation Language:** Mainly C.
4. **Vendor Support:** Technical support line, training, consultancy, newsletter.
5. **Marketed Since:** 1984, currently Version 6.1.
6. **Size of customer base:** 4000 copies.
7. **Methodologies/functions supported:**
 - i. **Software specification:** Some requirements extraction. DFDs, ST, etc. diagrams. Diagram balancing, database/diagram consistency checking. Traceability only through to process specs. Chen for information modeling. No automated database population, but notification of needed database changes.
 - ii. **Software design:** SC method. Schema generation for DB3.
8. **Documentation generation:** Fixed report formats, merges text/graphics. No 2167A support.
9. **Environment Characteristics:** Single-user, not recommended for use on a network.
10. **Database:** Data dictionary implemented as DB3. Split/merge facility.
11. **Output formats:** ASCII, PostScript, HPGL.
12. **User interface:** Menu and mouse, color, on-line help/tutorial, undo facility. Database browser/query facility.
13. **Adaptability:** Free-form graphics.

Information From: David Stephenson (703) 758-1501, May 14 1991.

Tool Summary: For real-time software.

1. **Hardware Platforms:** UNIX under X.
2. **Components:** Tool price \$1,995 single user, \$2,495 multi-user version. Includes Code Generator (CGEN) for Ada, C, Pascal.
3. **Tool Implementation Language:** Mainly C.
4. **Vendor Support:** Technical support line, training, consultancy, newsletter.
5. **Marketed Since:** 1990 in USA, currently Version 4.
6. **Size of customer base:** 20-30 customers in Europe, 6-7 USA.
7. **Methodologies/functions supported:**
 - i. **Software specification:** DFDs, ST, etc. with requirements extraction. Hardware/software allocation and capture of timing information. Chen information modeling. For static analysis syntax/semantic checking, diagram balancing, database/diagram consistency. Automated database population and flagging for needed changes. Traceability through to code.
 - ii. **Software design:** Structure charts and module specs.
 - iii. **Code generation:** Ada, C, Pascal.
8. **Documentation generation:** 2167A and user-definable formats.
9. **Project management support:** Configuration management, access control, change reporting.
10. **Environment Characteristics:** Multi-user and network support NetBIOS compatible networks, e.g., Novell, 3Com.
11. **Database:** Repository implemented as database. Database split/merge.
12. **Output formats:** PostScript, HPGL, HPLaserjet (PCL).
13. **User interface:** Menu and mouse, windowing, context-sensitive on-line help, undo facility. Database browser/query facility.
14. **Adaptability:** Free-form graphics.
15. **Planned enhancements:** Support for simulation/prototyping.

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